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D7.5 Prototypes of UPs ready for the user validation

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COOPERATION

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1. Introduction

This document provides a description of the developed prototypes ready for user validation. In the next sections a detailed description is provided about the developed services, portal gadgets, mobile applications, desktop applications, social networks, corporate websites and BI tools.

Network management includes the significant parts of the lenvis network. Therefore, the developed services are explained in detail.

For the portal, gadgets were developed to present the information from the different case studies. A detailed description of these gadgets is provided in this section.

Different mobile platforms were examined and mobile applications were developed which are connected to the lenvis network and showing information from the case studies. More detailed information on this topic can be found in this section.

To demonstrate the connectivity with the lenvis network from desktop applications, the P2P and TimeSerie Client applications were developed. Detailed information is provided in this section.

Integration with social networks was examined and developed for the lenvis network. The prototypes provide examples how Twitter and Facebook are connected to lenvis.

Corporate websites are explained in this document and few examples are provided on how corporate websites are used and integrated with lenvis.

A description is also provided about the BI tool prototype developed for lenvis where users are able to view predefined reports and analyse different data through the service network of lenvis.

2. Services

2.1. Network management

All registrations of providers, services and users are stored centrally in the network management system of Lenvis. We can distinguish four web services:

- Authentication Service – this service is responsible for user registration and authentication. It is available at http://lenvis.esaprojekt.pl/authentication. This service is secured. It means that when a client application wants to connect to this service, it has to pass correct credentials.
- Authorization Service - this service is responsible for user authorization and privilege management. It is available at http://lenvis.esaprojekt.pl/authorization. This service is secured. It means that when a client application wants to connect to this service, it has to pass correct credentials.
- Registry Publish Service – this service provides all necessary operation to register new and update existing information about service providers and web services. It is available at http://lenvis.esaprojekt.pl/registrypublish. This service is secured. It means that when a client application wants to connect to this service, it has to pass correct credentials.
- Registry Inquiry Service – this service provides interface for discovering services in the Registry. Services can be searched out according to various criteria, such as domain (Water/Air/Health), type of the service (TimeSeries/Grid/etc.) or localization. It is available at http://lenvis.esaprojekt.pl/registryinquiry. This web service is available publicly.
- Authentication and authorization web services are used by the Lenvis portal for user registration, authentication and user management.

Examples of use of the Registry Services are gadgets on the Lenvis portal where privileged users can register providers (Providers gadget) and web services (Services gadget) in the Lenvis Registry. Another example is a Windows Mobile 6.x Application where Registry Inquiry Service is used to look up a Data Service from which environmental data for the chart are retrieved.

2.2. Data services

2.2.1. Dutch case study services

A TimeSerie data service has been developed to provide KNMI data (meteorological and water quantity) to gadgets and applications in the lenvis network for the Netherlands area and the Dutch case study. The service provides TimeSerie data for different locations and variables. The service implements the *ILenvisTimeSerieService* interface of the lenvis network and is available for the complete lenvis platform. A detailed description of the service is provided in the following table.

Table 1 TimeSerie service description

Description	Provide historical and forecasting information of meteorological and water quantity data	
Locations	**ID**	**NAME**
	06210	VALKENBURG
	06235	DE KOOIJ
	06240	AMSTERDAM AP SCHIPHO
	06249	BERKHOUT
	06251	TERSCHELLING HOORN A
	06257	WIJK AAN ZEE

06260	De Bilt
06267	STAVOREN AWS
06269	LELYSTAD AP
06270	LEEUWARDEN
06273	MARKNESSE AWS
06275	DEELEN
06277	LAUWERSOOG AWS
06278	HEINO AWS
06279	HOOGEVEEN
06280	EELDE/GRONINGEN AP E
06283	HUPSEL AWS
06286	NIEUW BEERTA
06290	TWENTE
06310	VLISSINGEN
06319	WESTDORPE
06323	WILHELMINADORP AWS
06330	HOEK VAN HOLLAND
06344	ROTTERDAM AP ZESTIEN
06348	CABAUW TOWER
06350	GILZE RIJEN
06356	HERWIJNEN AWS
06370	EINDHOVEN AP
06375	VOLKEL
06377	ELL AWS
06380	BEEK/MAASTRICHT AP/M
06391	ARCEN AWS
06252	K13-A
Aa of Weerijs	Aa of Weerijs
Agger	Agger
Amertak	Amertak
Auvergne Polder	Auvergne Polder
Bakkersbergleiding	Bakkersbergleiding
Biggelaar	Biggelaar
Bloemendaal	Bloemendaal
Bosloop (de)	Bosloop (de)
Bovenmark	Bovenmark
Brandse Vaart	Brandse Vaart
Breda Centrum	Breda Centrum
Bremer	Bremer
Chaamsche Beek	Chaamsche Beek
De Bruin	De Bruin
Dintel	Dintel
Donge Noord	Donge Noord
Donge Zuid	Donge Zuid
Emilia	Emilia
Emmer	Emmer

	Endekweek	Endekweek
	Gansoijen	Gansoijen
	Goudbloem	Goudbloem
	Groote Leij	Groote Leij
	Haagse Beemden	Haagse Beemden
	Halsche Vliet (de)	Halsche Vliet (de)
	Hamse polder	Hamse polder
	Heerjansland	Heerjansland
	Hogediep	Hogediep
	Horsten	Horsten
	Kibbelvaart	Kibbelvaart
	Kraaienest	Kraaienest
	Kruislandse kreken	Kruislandse kreken
	Laakdijk	Laakdijk
	Langstraat	Langstraat
	Leurschans	Leurschans
	Ligne	Ligne
	Lokkervaart	Lokkervaart
	Markiezaatsmeer	Markiezaatsmeer
	Merkske	Merkske
	Molenbeek	Molenbeek
	Molenleij	Molenleij
	Niervaert	Niervaert
	Noordpolder Ossendrecht	Noordpolder Ossendrecht
	Oude Leij	Oude Leij
	Overdiep	Overdiep
	Prinslandse polder	Prinslandse polder
	Rietkreek	Rietkreek
	Roode Vaart	Roode Vaart
	Schuddebeurs	Schuddebeurs
	Schuivenoord	Schuivenoord
	Strijbeeksche Beek	Strijbeeksche Beek
	Tonnekreek	Tonnekreek
	Turfvaart-Bijloop	Turfvaart-Bijloop
	Volkerak polders	Volkerak polders
	Vughtpolder	Vughtpolder
	Waalwijk	Waalwijk
	Westland	Westland
	Zellebergen	Zellebergen
	Zonzeel	Zonzeel
	Zoom (de)	Zoom (de)
	Zwartenbergse polder	Zwartenbergse polder
	06209	06209
	06225	IJMUIDEN
	06229	TEXELHORS WP

		06239		F3-FB-1	
		06242		VLIELAND	
		06248		WIJDENES	
		06254		06254	
		06258		HOUTRIBDIJK	
		06265		06265	
		06285		06285	
		06308		06308	
		06311		06311	
		06312		06312	
		06313		06313	
		06315		06315	
		06316		06316	
		06320		LICHTEILAND GOEREE	
		06321		EURO PLATFORM	
		06324		06324	
		06331		06331	
		06340		WOENSDRECHT	
		06343		ROTTERDAM GEULHAVEN	
		06428		SEMMERZAKE	
		06431		GENT/INDUSTRIE-ZONE	
		06450		ANTWERPEN/DEURNE	
		06451		BRUSSELS NATIONAL (A	
		06479		KLEINE BROGEL	
		10200		EMDEN-FLUGPLATZ	
		10306		RHEINE-BENTLAGE	
		10400		DUESSELDORF	
		10404		KALKAR	
Data	**Provider**	KNMI - http://www.knmi.nl/			
	Variables	**DataType**	**Id**	**Name**	**Unit**
		System.Double	103	Cloud coverage	mm
		System.String	104	Winddirection in regions	regions
		System.Double	105	Windspeed	m/s
		System.Double	106	Maximum windspeed	m/s
		System.Double	107	Actual temperature	degrees Celsius
		System.Double	108	Mimimum temperature	degrees Celsius
		System.Double	109	Maximum temperature	degrees Celsius
		System.Double	112	Dew point	degrees Celsius
		System.Double	113	Relative humidity	%
		System.Int32	114	Horizontal visibility	m
		System.Double	115	Atmospheric pressure	hPa
		System.Double	118	Precipitation per hour	mm/hour
		System.Int32	120	Global radiation	Joule/cm2
		System.Int32	121	Winddirection in degrees	degrees
		System.Double	201	Evaporation	mm
		System.Double	450	Waterbalance	mm

Service	**Manager**	HydroLogic
	Contract	Lenvis TimeSerie Service Contract
	Address	http://hydrologic.lenvis.eu/TimeSerie.svc

2.2.2. Italian case study services

As described in deliverable D6.4, University of Milano Bicocca (UNIMIB) has developed two web services. One web service is a lenvis data provider web service and implements the *ILenvisTimeSerieService* interface. The function of this service is to expose the data collected by UNIMIB for the two Italian case studies: city of Milan and city of Bari; in the next sections it will be possible to find more detailed descriptions with some examples of reports about our case studies. Data for the two case studies consist of time series of pollutant level measures and daily number of hospital admissions due to cardiovascular and respiratory diseases.

UNIMIB Data source service

This web service exposes through a single interface all the data collected by UNIMIB: health data and pollutants data too. The next table describes all the characteristics of this service.

Table 2 Description of UNIMIB Data source lenvis Time Series service.

Goal		This service provides pollutants and admissions data through Lenvis interface contract.
Description		Milan and Bari data are exposed by this service. Both pollutant and admission variables are provided.
Location		At the moment geographical locations are: *Location* — *longitude* — *latitude* Milano - via Senato — 9.197241 — 45.47058 Milano - P.zza Zavattari — 9.143486 — 45.47592 Milano - P.zza Abbiategrasso — 9.177492 — 45.42999 Milano - via Juvara — 9.221335 — 45.47339 Milano - viale Liguria — 9.171672 — 45.44377 Milano - viale Marche — 9.19417 — 45.49553 Milano - Parco Lambro — 9.246659 — 45.49449 Milano - Pascal Città Studi — 9.234365 — 45.47854 Milano - Verziere — 9.195703 — 45.46294 Milano — 9.190336 — 45.46416 Milano - Humanitas Hospital — 9.168159 — 45.37233 Milano - Auxologico Hospital — 9.16583 — 45.46947 Bari - Stadio S.Nicola — 16.8399 — 41.08486 Bari - Via M.L.King — 16.86226 — 41.10027 Bari - Viale Papa Giovanni XXIII — 16.86527 — 41.1071 Bari - Via Fanelli — 16.8865 — 41.08438 Bari - Corso Cavour — 16.87238 — 41.12218 Bari- Piazza Duca Savoia — 16.87417 — 41.11909 Bari - Rione Japigia — 16.89279 — 41.11313 Bari - Piazza Kennedy — 16.8592 — 41.10052 Bari — 16.86667 — 41.12528
Data	**Owner**	• ARPA Lombardia - http://www.arpalombardia.it • ALEE-AO - http://www.aleeao.it/ • Municipality of Bari - http://www.comune.bari.it • Humanitas Clinical Institute - http://www.humanitas.it • Italian Auxologico Institute - http://www.auxologico.it

	Manager	UNIMIB - http://www.unimib.it
	Source	At the moment all the collected data is stored in an Access data base but the data may be migrated to some other data base engine in order to improve the performances.
	Type	They are described in detail in D8.1, section 3.
	Parameters	Many pollutant quantities and admissions related to cardio-vascular and respiratory diseases. All are described in D8.1, section 3 and in D6.2.
Service	**Manager**	UNIMIB
	Contract	Lenvis TimeSerie Service Contract
	Address	http://unimib.services.lenvis.eu:8080/UNIMIBDataSourceService/LenvisDataSourceService?wsdl

UNIMIB Data source service: technical details.

Data are retrieved from the web service through the data access component developed by UNIMIB. The configuration properties file used to describe transformation flow and data mapping is the follow:

```
#
# ------------------------standard parameters-----------------------
#
sourceTypes = KettleWrapper
dataTypes = location, variable, sensor, timeSerieData

#
# ------------------------localization parameters---------------------------
# Default values for the section is the locale parameters of host running DAC
library

#ISO Language Code. These codes are the lower-case,two-letter codes as defined by
ISO-639
language = it
#ISO Country Code. These codes are the upper-case,two-letter codes as defined by
ISO-3166
country = IT
#The variant argument is a OS vendor or browser-specific code or some variant of
languages
variant = WIN


# -- kettle wrapper specific parameters--------------------
jobPath = ./etc/LenvisDataSource/DataSourceWS.kjb

# -- information regarding the transformation structure-------------
transformationJobNames = DataSourceWS
DataSourceWS.supportedQuery = select

#filterSQL is semi-dynamic node, then there is a node with this name in the
static transformation
DataSourceWS.select.dynamicNodeNames = dataNode, renaming

# Type of the kettle transformation step generated dynamically
DataSourceWS.select.dataNode.type = filterSQL
DataSourceWS.select.dataNode.prePosition = PRE_FILTER
DataSourceWS.select.dataNode.postPosition = POST_FILTER

DataSourceWS.select.renaming.type = filterJS
DataSourceWS.select.renaming.prePosition = PRE_RENAMING
DataSourceWS.select.renaming.postPosition = POST_RENAMING

#-----------------Mapping Data Information-----------------
variable = Variable
variable.id = id_variable
```

```
variable.name = variableName
variable.dataType = dataType
variable.unit = unit

timeSerieData = NormalizedData
timeSerieData.id = id_data
timeSerieData.date = sampleDate, MM/dd/yyyy, null, #
timeSerieData.value = dataValue
timeSerieData.sensorId = sensorId

location = Location
location.id = id_loc
location.idFromSource = idFromSource_loc
location.nameFromSource = nameFromSource_loc
location.longitude = longitude
location.latitude = latitude
location.height = height
location.depth = depth

sensor = Sensor
sensor.id = id_sensor
sensor.idFromSource = idFromSource_sensor
sensor.nameFromSource = nameFromSource_sensor
sensor.locationId = locationId
sensor.variableId = variableId
```

In this example, the source is a database composed by 4 tables: location, variable, sensor and NormalizedData; each corresponding to a data access component data type. The simplified diagram of the data source is reported below.

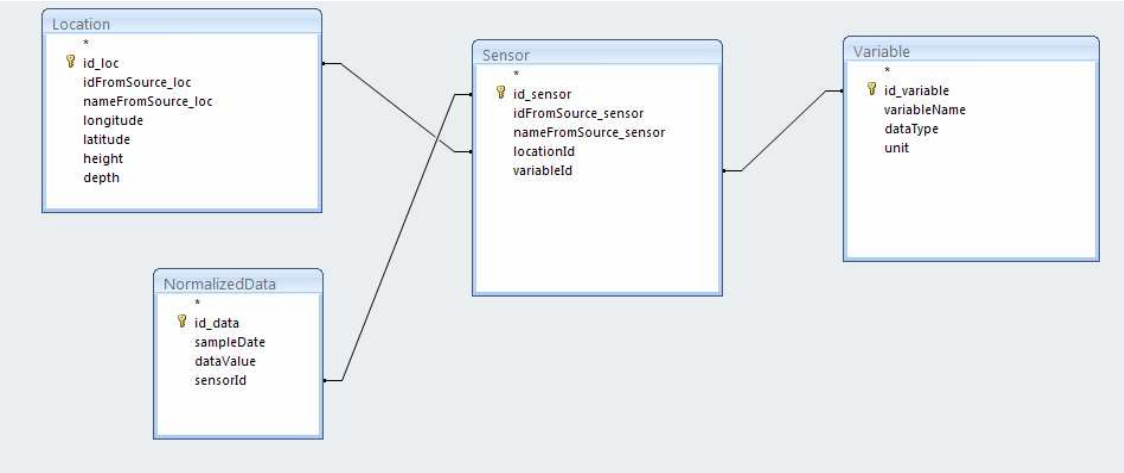


Figure 1 Data source E-R diagram

A full description of the properties file for the data access component was already reported in D6.3.

UNIMIB HIDSS service

The second web service (named HIDSS: Health Impact Decision Support System) is a more complex one. It also implements the *ILenvisTimeSerieService* interface but the time series provided is not historical data but short term forecasts. The next table describes all the characteristics of this service.

Table B Description of UNIMIB HIDSS lenvis Time Series service.

Goal	This service provides forecasted admission values on the base of pollutant

		levels read by the service.
Description		Milan and Bari data are exposed by this service. Both pollutant and admission variables are provided.
Location		At the moment the only location on which it is possible to forecast is Milan thanks to the presence of ALEE-AO that is a source with a high number of daily admissions.
Data	**Owner**	• ARPA Lombardia – http://www.arpalombardia.it • ALEE-AO - http://www.aleeao.it
	Manager	UNIMIB - http://www.unimib.it
	Source	Forecasted data are produced starting from the pollutants and admissions present in the same Access data base exposed by the UNIMIB Data source service.
	Type	Forecasting.
	Parameters	• Cardio-vascular admissions • Respiratory admissions
Service	**Manager**	UNIMIB
	Contract	Lenvis TimeSerie Service Contract
	Address	http://unimib.services.lenvis.eu:8080/HIDSSForecastService/HIDSSService?wsdl

UNIMIB HIDSS service: technical details

HIDSS integrates through JABuilder technology and MCR (Matlab Compiler Runtime) a set of Matlab scripts executing AHMM (Autoregressive Hidden Markov Model) for forecasting the admissions time series. This model needs as input a short window of pollutants-admissions time series in order to produce as output a short-term forecasted admissions time series, so the service calls the UNIMIB data access component for retrieving the necessary input.

HIDSS needs some configuration parameters for properly execute AHMM and implements *ILenvisTimeSerieService* methods with a coherent semantic so it reads a specific configuration properties file in addition to the configuration file for the data access component. In the box below there is an example of HIDSS configuration to handle the forecast of two different time series:

```
learnedY = 56, 57
56.learnedX = 62, 66, 70
56.modelPath = ./etc/HIDSS/param_0001_.mat
56.parametersPath = ./etc/HIDSS/provaConfig.txt
56.dataFreshness = 2008-12-31T00:00:00
56.startData = 1998-01-01T00:00:00
56.lastDataNumber = 10
56.minLastDataNumber = 6
56.forecastNumber = 5


57.learnedX = 62, 66, 70
57.modelPath = ./etc/HIDSS/param_0001_.mat
57.parametersPath = ./etc/HIDSS/provaConfig.txt
57.dataFreshness = 2008-12-31T00:00:00
57.startData = 1998-01-01T00:00:00
57.lastDataNumber = 10
57.minLastDataNumber = 6
57.forecastNumber = 5
```

LearnedY property indicates the ID list of time series that can be forecasted by the web service. For each of these IDs more sub-properties must be specified:

- learnedX sub-property indicates the ID list of pollutants time series used as input for the AHMM.

- modelPath sub-property contains the path of the Matlab AHMM model used by the Matlab script recall from HIDSS
- parametersPath sub-property contains the path of the file that contains specific parameters for the model referenced by modelPath property
- dataFreshness indicates date of the most recent historical data. Any later date is considered future and cannot be used by HIDSS as historical data input for the model.
- startData indicates the first historical data retrieved by the service
- lastDataNumber is the size of window of historical data used as input of AHMM model in order to perform forecasting.
- minLastDataNumber is the minimum number of not missed values data in the historical data window necessary to allow a forecasting.
- forecastNumber is the number of values generated by the forecasting model.

This parameterized structure allows HIDSS to manage forecasting of many time series each with specific model and parameters. In particular, the properties *dataFreshness*, *startData*, *lastDataNumber*, *minLastDataNumber* and *forecastNumber*, together determines for which dates of the given ID time series HIDSS can provide a forecasted value.

If the number of missed values in the historical data window retrieved for a forecasting is greater than (lastDataNumber – minLastDataNumber) forecasting is not allowed. This is because missed values are not allowed by AHMM, so input data for the forecasting is interpolated in order to fill any missed values. However it is clear that an excessive presence of missed values makes the forecast unreliable, so the properties *lastDataNumber* and *minLastDataNumber* are used to configure the trade-off between availability of forecast values, even in presence of some missed values, and reliability of the forecasting.

In a similar way, no inferences can be made for data prior to startDate because there is no historical data to pass as input to the AHMM and, for the same cause, no inferences can be made for data later than (dataFreshness + forecastNumber).

2.2.3. Portuguese case study services

Hydrometric Stations

Automatic hydrometric stations are a very important source of information for nowcast/forecast of water quality in beaches located downstream of creeks and rivers. In the Portuguese study, this is the case. In this study the main sources of faecal contamination events in the beaches under study in the framework of lenvis are creeks (e.g. Sassoeiros e Marianas). These small creeks under normal summer conditions have a very low flow. Under these conditions the flow is divert to the sewer system using small wood dykes. However, under strong precipitation events, the dykes are overflown and beaches suffer significant faecal contamination. This web service enables the development of clients (e.g. gadgets) focused in informing the users of the creek flow conditions and the potential impact of each creek over the beaches water quality. The Hydrometric Stations Time Series service characteristics are enumerated in detail in the following table.

Table 3 Description of the Hydrometric stations lenvis Time Series service.

Goal	This service provides creek hydrometric station data through lenvis contract
Description	To know when creek water level overlaps the wood dike responsible for divert the creek flow to the Waste Water Treatment plan.
Location	For now 2 Points: • Sassoeiros - Longitude: -9.3389, Latitude: 38.6805, • Marianas - Longitude: -9.3486, Latitude: 38.682

Data	**Owner**	SANEST - http://www.sanest.pt
	Manager	IST - http://www.mohid.com/tejo-op/aq_dados_campo.htm
	Source	All the data measured by the sensor is stored in automatic way in an Access database by IST.
	Type	Hydrometric station described in detail in D3.2, chapter 4.1.2
	Parameters	Water level River flow (estimated from a flow curve)
Service	**Manager**	Hidromod
	Contract	lenvis TimeSerie Service Contract
	Address	http://www.hidromod.com/Lenvis/LenvisTSISTService/LenvisTimeSerieServiceIST.svc

Meteorological Station

The coastline is an area of strong atmospheric gradients due to the differences between Ocean-Atmosphere and Land-Atmosphere interactions. More specifically in beach areas the land topography can generate intense variability at the local scale mainly in the wind circulation. This is the case of the Lisbon study area where topographic features (e.g. Sintra Ridge) located North of the beaches under study induce a strong wind attenuation for winds from the North quadrant (dominant quadrant in this area). These local scale processes are difficult to solve with mesoscale models like MM5 and WRF. A time series service for a meteorological station is important to have in real time the atmospheric conditions of the area. This station is also important in the validation procedure of the weather forecast model. The meteorological station in the Lisbon study site is located in the Guia Waste Water Treatment plant (high quality touristic area) being also an important input for odours dispersion studies. The Meteorological Stations Time Series Service characteristics are enumerated in detail in following table.

Table 4 Description of the Meteorological stations lenvis Time Series service.

Goal		This service provides creek hydrometric station data through lenvis contract
Description		This service provides meteorological station data through lenvis contract.
Location		Guia • Longitude: -9.447405 • Latitude: 38.695501
Data	**Owner**	SANEST - http://www.sanest.pt
	Manager	IST - http://www.mohid.com/tejo-op/aq_dados_campo.htm
	Source	All the data measured by the sensor is stored in automatic way in an Access database by IST.
	Type	Meteorological station described in detail in D3.2, chapter 4.1.2
	Parameters	Precipitation, Solar radiation, Wind Speed, Wind Direction, Prevailing Winds Direction, Atmospheric Pressure, Temperature, Humidity
Service	**Manager**	Hidromod
	Contract	lenvis TimeSerie Service Contract
	Address	http://www.hidromod.com/Lenvis/LenvisTSISTService/LenvisTimeSerieServiceIST.svc

Bathing Water Quality

The Portuguese national water authority (INAG) manages a large database (SNIRH) of water quantity and quality. This information is available through the site http://snirh.pt/. The Bathing Water Quality Time Series Service aims to give access to Lenvis Clients to subsets of SNIRH. For now the focus is microbial data. However, this can be extended to any other type of parameters

available in SNIRH. It is important to beach stakeholders to be able to have access in an efficient way to the national water data but also to disseminate among the general public this information. The Bathing Water Quality Stations Time Series Service characteristics are enumerated in detail in the following table.

Table 5 Description of the Bathing Water Quality stations lenvis Time Series service.

Goal		Monitor beaches water quality.
Description		This service provides bathing water quality data through lenvis contract
Location		Carcavelos beach • Longitude: -9.34222 • Latitude: 38.68194 Torre beach • Longitude: -9.32306 • Latitude: 38.67583 Santo Amaro de Oeiras beach • Longitude: -9.335 • Latitude: 38.685
Data	**Owner**	INAG - http://www.inag.pt/
	Manager	INAG - http://www.inag.pt/
	Source	SNIRH database (http://snirh.pt/). Access via http.
	Type	Measured by microbiological laboratory analysis.
	Parameters	E. Coli, Faecal Coliforms
Service	**Manager**	Hidromod
	Contract	Lenvis TimeSerie Service Contract
	Address	http://www.hidromod.com/Lenvis/INAGTS/LenvisTimeSerieServiceINAG.svc

Local Scale Coastal Forecast

Water quality forecasts are performed daily by MOHID Water, using Tagus hydrodynamic forecasts (also performed by MOHID Water), meteorological forecasts from MM5, stream data from automatic hydrometric stations installed in the streams, and streams historical data (faecal contamination and discharges).

IST has also developed a methodology to evaluate the effect on bathing water quality from streams discharges (due to faecal contamination), considering the amount of faecal contamination and the probability that a bather has of encountering it. Using the New Bathing Water Directive (Directive 2006/07/CE) quality limits as reference, three bathing water quality levels were established:

- Bad Water Quality: when the probability of a bather to be exposed to the faecal contamination is bigger than 5%.
- Sufficient Water Quality: when the probability of exposure to faecal contamination ranges between]1-5[%.
- Good Water Quality: when the probability of a bather to be exposed to the faecal contamination is less than 1%.

For each beach (Carcavelos, Torre, and Santo Amaro de Oeiras), a forecast of hydrodynamic conditions and water quality for the next days is generated. These forecasts are disseminated via time series service entitled Local Scale Coastal Forecast. Under the framework of the new Bathing Water Directive, the ability to forecast short term pollution events can be critical from the touristic point of view. If during these periods bathing activities are forbidden, up to 15% of the monitoring samples can be discarded in the water quality evaluation of the beach. To disseminate these forecasts via a web service with a well-described contract available via the lenvis network can be an important added value. Local Scale Coastal Forecast Stations Time Series Service characteristics are enumerated in detail in the following table.

Table 6 Description of the Local Scale Coastal Forecast stations lenvis Time Series service.

Goal		Monitor beaches water quality and hydrodynamic conditions.
Description		This service provides local scale coastal and water quality forecast through lenvis contract.
Location		Carcavelos beach • Longitude: -9.34222 • Latitude: 38.68194 Torre beach • Longitude: -9.32306 • Latitude: 38.67583 Santo Amaro de Oeiras beach • Longitude: -9.335 • Latitude: 38.685
Data	**Owner**	SANEST - http://www.sanest.pt
	Manager	IST - http://www.maretec.mohid.com/projects/lenvis/
	Source	MOHID time series ASCII files
	Type	Time series numerical model (http://ww.mohid.com) results
	Parameters	E. Coli, Faecal Coliforms, Current Direction, Current Intensity, sea level
Service	**Manager**	Hidromod
	Contract	Lenvis TimeSerie Service Contract
	Address	http://www.hidromod.com/Lenvis/MOHIDIST/LenvisTimeSerieServiceMOHID.svc

Sewer Forecast

In beaches near large urban areas, combined sewer overflows and emergency discharges due to sewer network operation (e.g. failures in pumping stations or in the wastewater treatment plant) can be an important origin of water quality in beaches. In the Lisbon site a water utility responsible for the sewer management of the Northern margin of the Tagus estuary interior (SIMTEJO) will share Combined Sewer Overflows forecasts via a time series web service following the lenvis contract. SIMTEJO has several sewer models implemented and being run in operational mode by Hidromod. This model results could be used by any lenvis client able to read the Lenvis Time Series contract. The Local Scale Coastal Forecast Stations Time Series Service characteristics are enumerated in detail in the following table.

Table 7 Description of the Sewer Forecast stations Lenvis Time Series service.

Goal		Monitor Combined Sewer Overflows or Emergency discharges impact over the water quality
Description		This service provides sewer discharges forecast in the estuary through lenvis contract.
Location		Alcântara Longitude: -9.18 Latitude: 38.7 Beirolas Longitude: -9.083 Latitude: 38.78333
Data	**Owner**	SIMTEJO - http://www.simtejo.pt/
	Manager	Hidromod
	Source	SQL server data base
	Type	Time series generate by SWMM numerical model (http://www.epa.gov/ednnrmrl/models/swmm/)
	Parameters	Flow, Faecal coliforms concentration
	Manager	Hidromod

Service	**Contract**	Lenvis TimeSerie Service Contract
	Address	http://www.hidromod.com/Lenvis/SEWERTS/LenvisTimeSerieServiceSEWER.svc

Grid Forecasts

In the Lisbon case study, the Lenvis grid service contract is used to disseminate the physical forecasts (circulation, waves, and atmosphere). There is great interest in physical forecasts, especially waves because of the surf activity. The grid services are an efficient way to disseminate these results between the general public. However, these physical forecasts are also of great interest for forcing other numerical models. For example, the atmospheric model is used to force hydrodynamic and wave models. The hydrodynamic model can be use as boundary condition of very high-resolution models. This approach has been followed in the modelling community (OpenDAP) to replace the more chaotic approach of using ftp to disseminate data. The Lenvis Grid data service can be seen has an Extended OpenDap service, in other words an OpenDap service with more sophisticated methods. The coast, wave and atmosphere Grid Service characteristics are enumerated in detail in the following tables.

Table 8 Description of the Coastal Forecast Lenvis grid service.

Goal		Forecast Hydrodynamic conditions along the Portuguese coast
Description		This service provides coastal scale hydrodynamic forecasts.

Location		Grid domain
		• Name : Portugal
		• Area :
		  • North/West: 46.56232,-15.64125
		  • North/East: 46.56232,-1.35875
		  • South/East: 33.12183,-2.77075
		  • South/West: 33.12183,-14.22925

Data	**Owner**	IST (http://www.mohid.com/operational/) and Hidromod
	Manager	IST (http://www.mohid.com/operational/) and Hidromod
	Source	MOHID fields in hdf5 file format (http://www.mohid.com/wiki/index.php?title=HDF_file)
	Type	Numerical model (http://www.mohid.com) data fields results
	Parameters	Temperature, Salinity, Current Direction, Current Intensity, sea level
Service	**Manager**	Hidromod
	Contract	Lenvis TimeSerie Service Contract Lenvis Grid Service Contract
	Address	http://www.hidromod.com/Lenvis/PCOMSIST/

Table 9 Description of the Wave Forecast Lenvis grid service.

Goal		Very high resolution wave conditions forecasts in Carcavelos and Torre beach
Description		This service provides wave forecast data through Lenvis contract.

Location		Grid domain
		• Name : Tagus mouth
		• Area :
		  • North/West: 46.56232,-15.64125
		  • North/East: 46.56232,-1.35875
		  • South/East: 33.12183,-2.77075
		  • South/West: 33.12183,-14.22925

Data	**Owner**	Hidromod
	Manager	Hidromod (http://www.hidromod.pt/forecast/default.aspx)
	Source	SWAN model results fields in MOHID hdf5 file format (http://www.mohid.com/wiki/index.php?title=HDF_file)
	Type	Predicted by the WaveWatch III (http://polar.ncep.noaa.gov/waves/wavewatch/) and SWAN (http://www.wldelft.nl/soft/swan/) waves numerical models
	Parameters	Mean wave period and direction and significant wave height
Service	**Manager**	Hidromod
	Contract	Lenvis TimeSerie Service Contract Lenvis Grid Service Contract
	Address	http://www.hidromod.com/Lenvis/SWAN/

Table 10 Description of the Atmospheric Forecast Lenvis grid service.

Goal		Atmospheric conditions forecasts along the Portuguese coast
Description		This service provides atmospheric forecast data through Lenvis contract.

Location		Grid domain
		• Name : Portugal
		• Area :
		  • North/West: 46.56232,-15.64125
		  • North/East: 46.56232,-1.35875
		  • South/East: 33.12183,-2.77075
		  • South/West: 33.12183,-14.22925

Data	**Owner**	IST - http://meteo.ist.utl.pt/new/
	Manager	IST - http://meteo.ist.utl.pt/new/
	Source	MM5 model results fields in MOHID hdf5 file format (http://www.mohid.com/wiki/index.php?title=HDF_file)
	Type	Predicted by the MM5 atmospheric model
	Parameters	Precipitation, Wind Velocity, Air Temperature, Relative Humidity, SW Radiation, Up LW Radiation, Down LW Radiation, Atmospheric Pressure, Latent Heat, Sensible Heat
Service	**Manager**	Hidromod
	Contract	Lenvis TimeSerie Service Contract Lenvis Grid Service Contract
	Address	http://www.hidromod.com/Lenvis/MM5/

2.3. Feedback services

One way to assess the quality of the data provided by the services available in the lenvis platform is through user feedbacks. These feedbacks play an important role especially to the data providers. The feedback service will gather information from the web portal and the mobile applications and provide it to the Business Intelligence engine.

2.3.1. Overview

User feedback will be available to the lenvis platform as a web service, to be in line with the Service Oriented Architecture design principles chosen for this project.
The next figure shows a general view of the interaction between the different services necessary to make the User Feedback gadget fully functional and posterior consumption of feedback data by the BI engine.

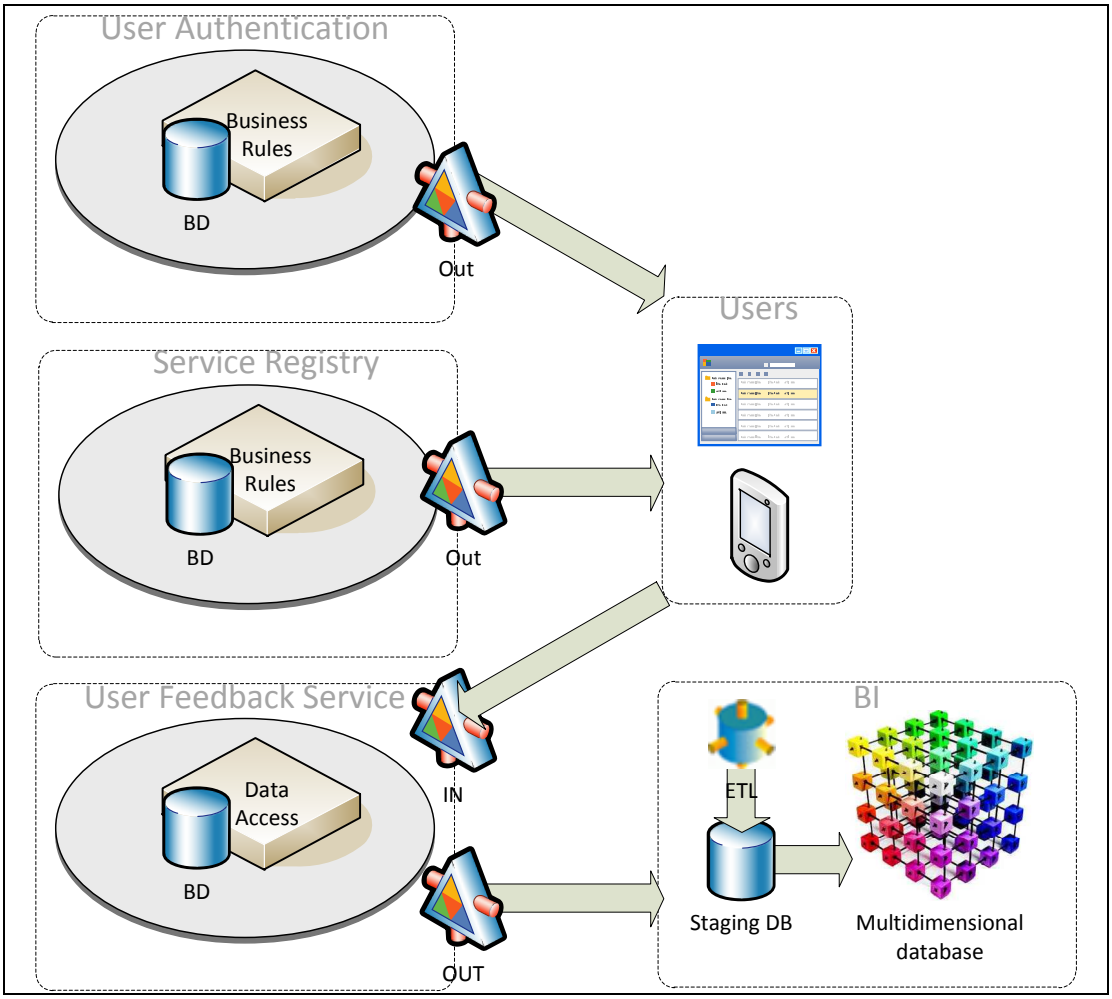


Figure 2 - High level view of User Feedback Service.

The user feedback service will only store and distribute the user feedback data, since all business logic will be present at the gadgets. The User Feedback Service stores all the feedbacks from the Portal and Mobile Applications and makes it available to services, such as the Business Intelligence Engine.

2.3.2. Generic feedback gadgets workflow

All the feedback gadgets have a common generic workflow. There are differences in the specificity of the response given by the gadget, since it might be specific for a service or generic for the services available for the user.

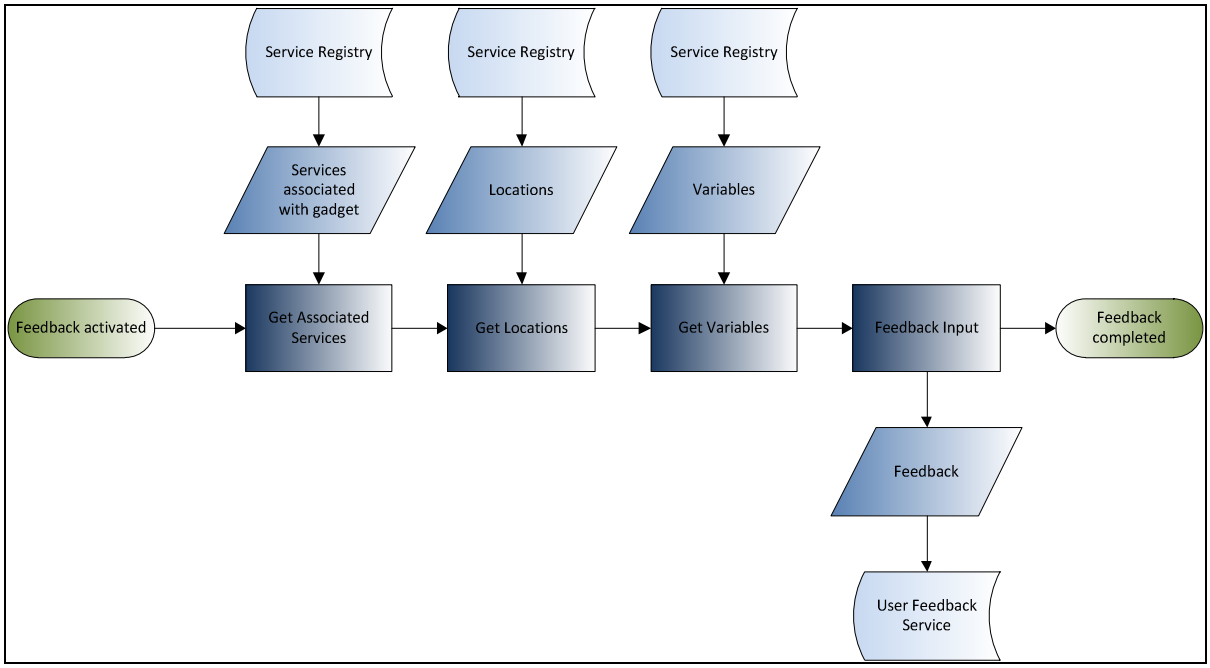


Figure 3 - User Feedback Gadget Generic Workflow

The first step for the feedback gadget is to know its parent gadget available services. Depending on the specificity of this parent gadget (it might be a generic feedback or specific for a service) the gadget will ask the service registry for more data or not.

The Service Registry Service will resolve information for the services associated to the targeted gadget. This step is fundamental for the association between feedback and services, used on the Business Intelligence engine.

With the Services list, the User Feedback Gadget can ask the locations that the selected Data Service covers, and then the available variables. After gathering all the needed data, the user can give feedback to a specific variable/location/service combination.

The user can take photos, provide some descriptive text and classify the service within a 0..100 scale. It can also report the intensity and extension of a problem and the location. All this information can be consumed through the web service layer.

2.3.3. Feedback data structure

The data structure used in feedback is very simple and straightforward.

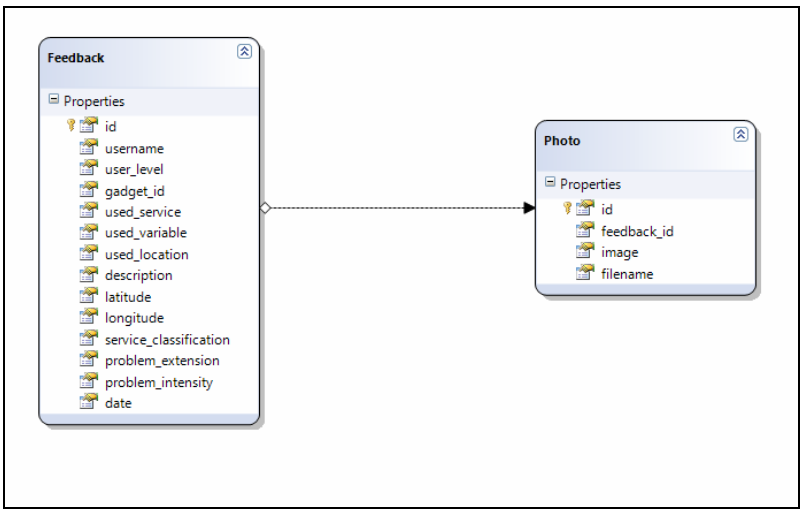


Figure 4 - User Feedback data structure

The data structure is composed by two tables, one for the feedback data and another for the related photos taken by the end user. A feedback can have many photos associated with it. The feedback table contains all the feedback from the user input:

- *Id* – entry identification;
- *Username* – user username;
- *User_level* – user access level (Red, Yellow or Green);
- *Gadget_id* – Id of the gadget that the feedback relates;
- *Used_service* – the service related to the feedback;
- *Used_Variable* – feedback target variable. This variable comes from the data provider service;
- *Used_location* – feedback target location. This location comes from the data provider service;
- *Description* – text inserted by the user;
- *Latitude* – latitude of the feedback;
- *Longitude* – longitude of the feedback;
- *Service_classification* – classification given by the user to the service/variable/location;
- *Problem_extension* – value given by the user for the problem extension;
- *Problem_intensity* - value given by the user for the problem intensity;
- *Date* – feedback date.

The Photo table will retain the photos taken by the users from user feedback gadgets. The table is composed by:

- *Id* – photo sequential id;
- *Feedback_id* – to relate with feedback table;
- *Image* – image taken;
- *Filename* – name of the file with the submitted picture.

2.3.4. Web service interface

This web service is composed of 8 operations and allows another service to submit and check feedbacks entered by the users.

```
[ServiceContract]
public interface IUserFeedback
{
    [OperationContract]
    long SendNewFeedback(string username, string description, int gadgetId, int usedService,
                         string usedVariable, string usedLocation, float latitude, float longitude,
                         int serviceClassification, int problemExtension, int problemIntensity);

    [OperationContract]
    string AttachPhoto(long feedbackId, string filename, byte[] photo);

    [OperationContract]
    Feedback[] GetAllFeedbacks();

    [OperationContract]
    Feedback GetFeedbackWithId(int id);

    [OperationContract]
    Feedback[] GetFeedbacks(int count);

    [OperationContract]
    Feedback[] GetFeedbacksFromGadget(int gadgetId);

    [OperationContract]
    Photo[] GetFeedbackPhotos(int feedbackId);
}
```

Figure 5 - Web service operations

The first two webmethods are used to submit new feedbacks:

- SendNewFeedback – interface for a new feedback;
- AttachPhoto – to be used after submitting a feedback. It allows attaching a photo to a feedback.

The rest of the webmethods allows other services consuming the feedback data:

- GetAllFeedbacks – returns a list of all feedbacks existing in the database;
- GetFeedbackWithId – returns a specific feedback with a specific Id;
- GetFeedbacks – returns the latest feedbacks. The number of wanted feedbacks are passed as a parameter to the webmethod;
- GetFeedbacksFromGadget – returns all the feedbacks specific to the gadget whom Id is passed to the webmethod parameter;
- GetFeedbackPhotos – returns all the photos of a specific feedback.

3. Portal gadgets

3.1. Beach Lisbon Quality

Two gadgets were developed thinking to the surfing community. This focus in the surf community is to establish a two-way interaction. The gadgets give them information of their interest and we expect to have their inputs via the feedback service. This way it is possible to establish a win-win relation with a sophisticated community used to informatics tools that is present at the beach all year long. One of the gadgets “Beach Lisbon Quality” allows the visualization per beach of XY graphics of all parameters considered important for the surf community. The second gadget “Beach Lisbon Waves” is focus in the map visualization of wave forecasts at the beach scale. The “Beach Lisbon Quality” and “Beach Lisbon Waves” Gadgets characteristics are enumerated in detail in Table 9 and Table 10 respectively.

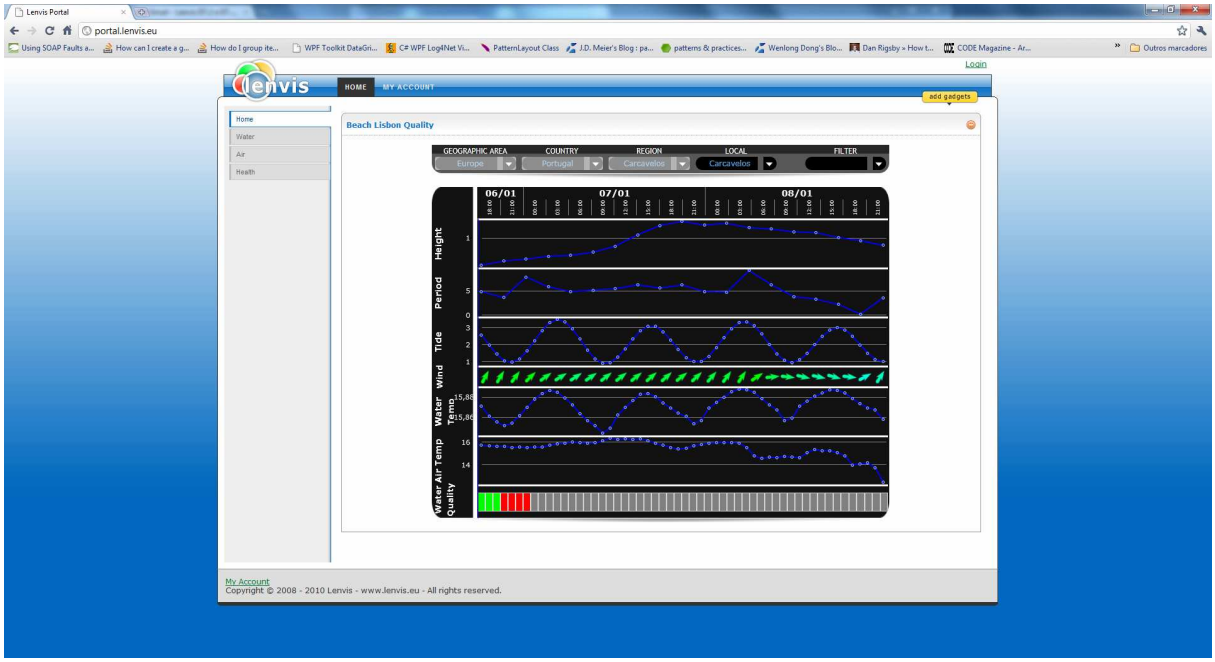


Figure 6 View of the "Beach Lisbon Gadget" gadget showed inside the Lenvis Portal.

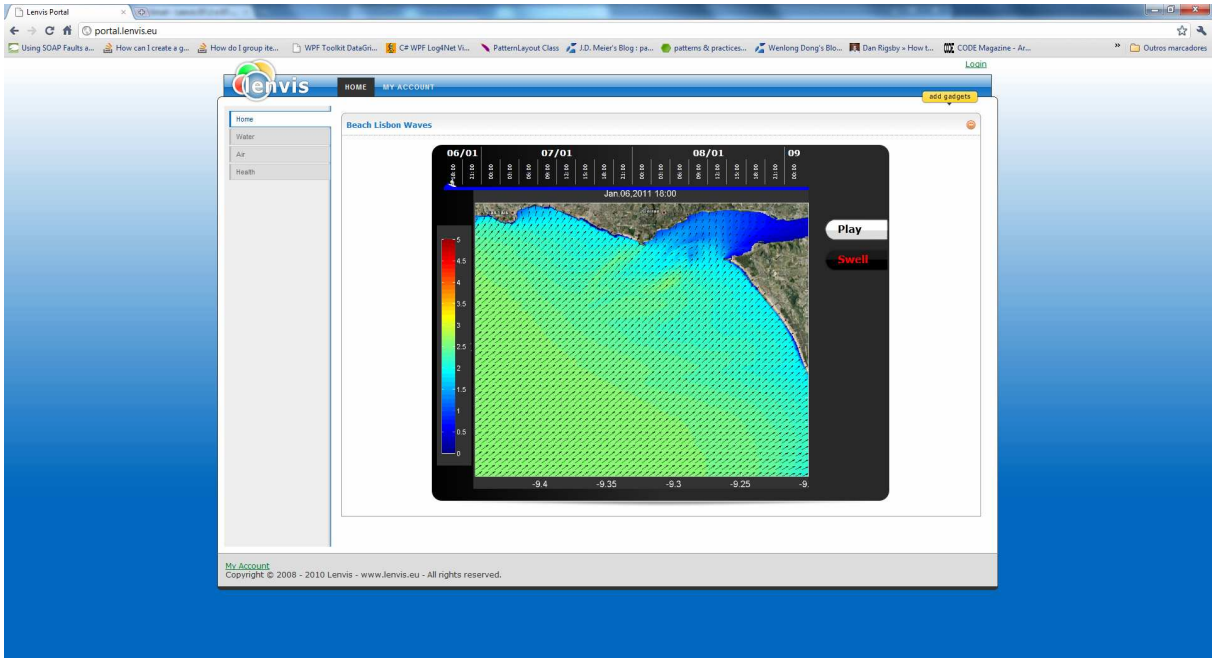


Figure 7 View of the "Beach Lisbon Waves" gadget showed inside the Lenvis Portal.

Table 11 Description of the "Beach Lisbon Quality" gadget

Goal		Forecast wave, hydrodynamic and quality conditions along Estoril coast.
Description		This gadget shows the time series forecasts of physical and quality conditions in three points in Estoril coast.
Location		Carcavelos beach • Longitude: -9.34222 • Latitude: 38.68194 Torre beach • Longitude: -9.32306 • Latitude: 38.67583 Santo Amaro de Oeiras beach • Longitude: -9.335 • Latitude: 38.685
Data	**Services**	• http://www.hidromod.com/Lenvis/MOHIDIST/LenvisTimeSerieServiceMOHID.svc (water quality and tide) • http://www.hidromod.com/Lenvis/SWAN/ (wave conditions) • http://www.hidromod.com/Lenvis/MM5/ (atmospheric conditions)
	Parameters	Wave Height, Wave Period, Tide, Wind Direction, Wind Speed, Water Temperature, Air Temperature, Water Quality
Access		Lenvis Portal – Water gadgets - Beach Lisbon Quality (http://portal.lenvis.eu)
Users		General public and professional users

Table 12 Description of the "Beach Lisbon Waves" gadget

Goal		Show maps of very high resolution wave conditions forecast in the Tagus mouth area
Description		This gadget allows the end user to have access to very high-resolution wave conditions forecast in the Tagus mouth area via http.
Location		Grid domain • Name : Tagus mouth Area : • North/West: 46.56232,-15.64125 • North/East: 46.56232,-1.35875 • South/East: 33.12183,-2.77075 • South/West: 33.12183,-14.22925
Data	**Services**	http://www.hidromod.com/Lenvis/SWAN/ (wave conditions)
	Parameters	Wave height, wave direction
Access		Lenvis Portal – Water gadgets - Beach Lisbon Waves (http://portal.lenvis.eu)
User		General public and professional users

3.2. Providers gadget

Privileged users are able to register a Lenvis Providers in the Registry. When the user enters a Providers tab on the portal a list of providers will be displayed as shown on the picture below.

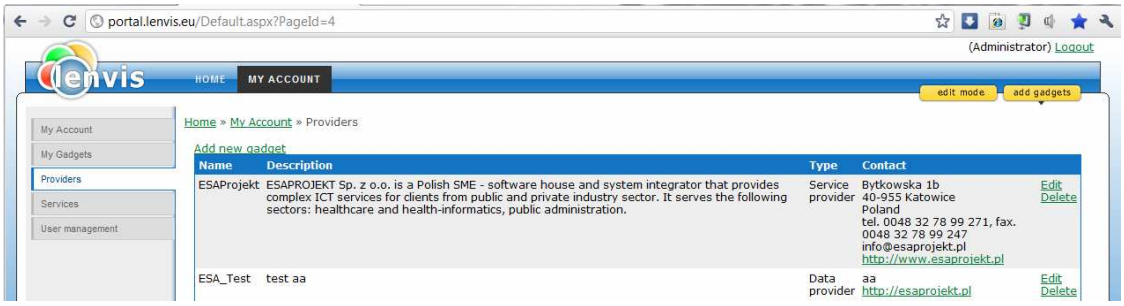


Figure 8 Providers gadget – List of Providers

The information about providers from the list can be modified or a new provider can be added. On the picture below a Modify provider window is shown.

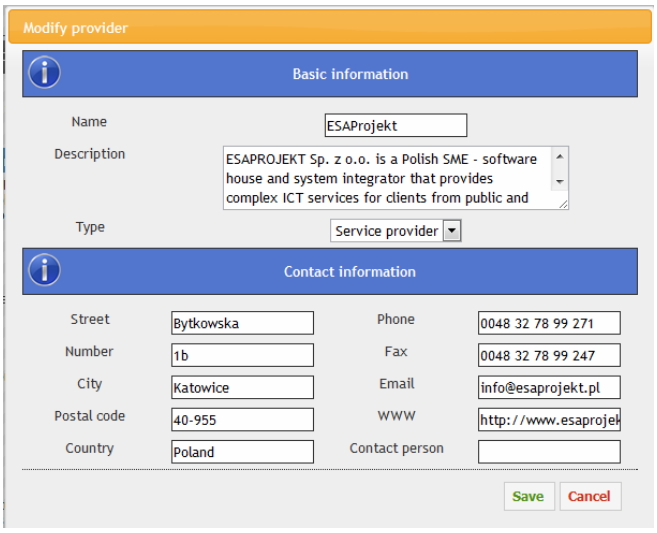


Figure 9 Providers gadget – Modify provider window

Following information are required to register a provider:

- Name – unique name of the provider
- Provider type – type of the provider (ServiceProvider/DataProvider/etc.)

3.3. Services gadget

Privileged users are able to register a web service in the Registry. When the user enters a Services tab on the portal a list of registered web services will be displayed as shown on the picture below.

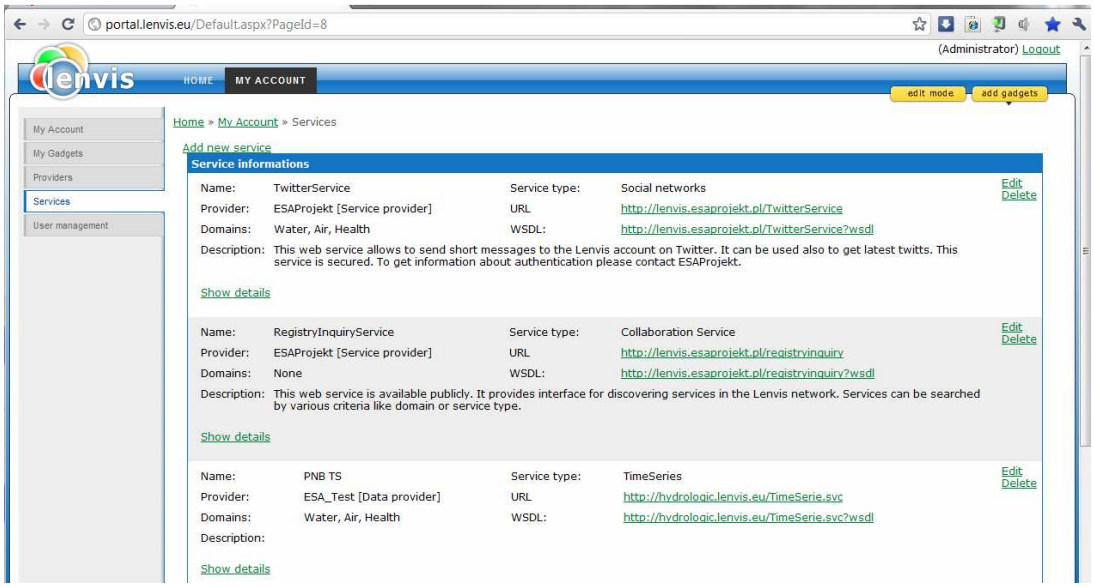


Figure 10 Service gadget – Services list

The information about web services from the list can be modified or a new web service can be added. On the picture below a Modify service window is shown.

Figure 11 Service gadget - Modify service window

Following information are required to register a web service:

- Provider – an organization or company which provides the web service
- Name – unique name of the service
- Service type – type of the service (TimeSeries/Grid/etc.)
- Domain – Water/Air/Health
- Url – address of the service
- Wsdl – address of the WSDL file, which describes messages and operations provided by the registered web service.
- Security Level – security level of the web service:
    - GREEN – data can be accessed by everybody.
    - YELLOW – data can be accessed only by registered users.
    - RED - data can be accessed only by users specified by the service registrar.

3.4. User management gadget

The User Management gadget is available only for the users with administrator rights. The most important option is user privileges management. The picture below presents User management page.

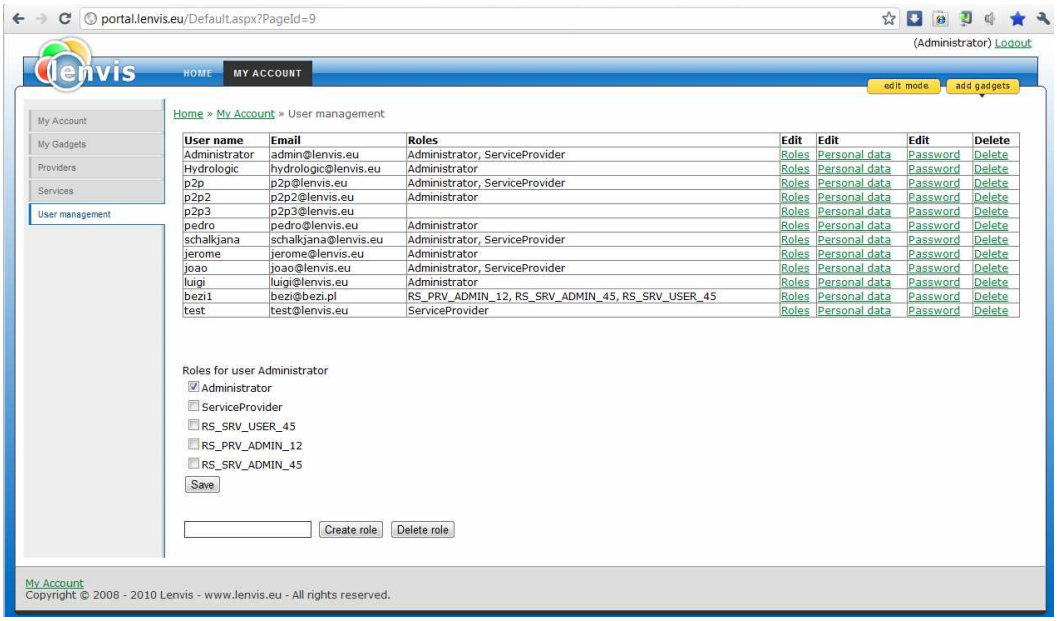


Figure 12 User management gadget

3.5. User feedback gadget

The following picture shows a view of the submitting page of the user feedback web gadget.

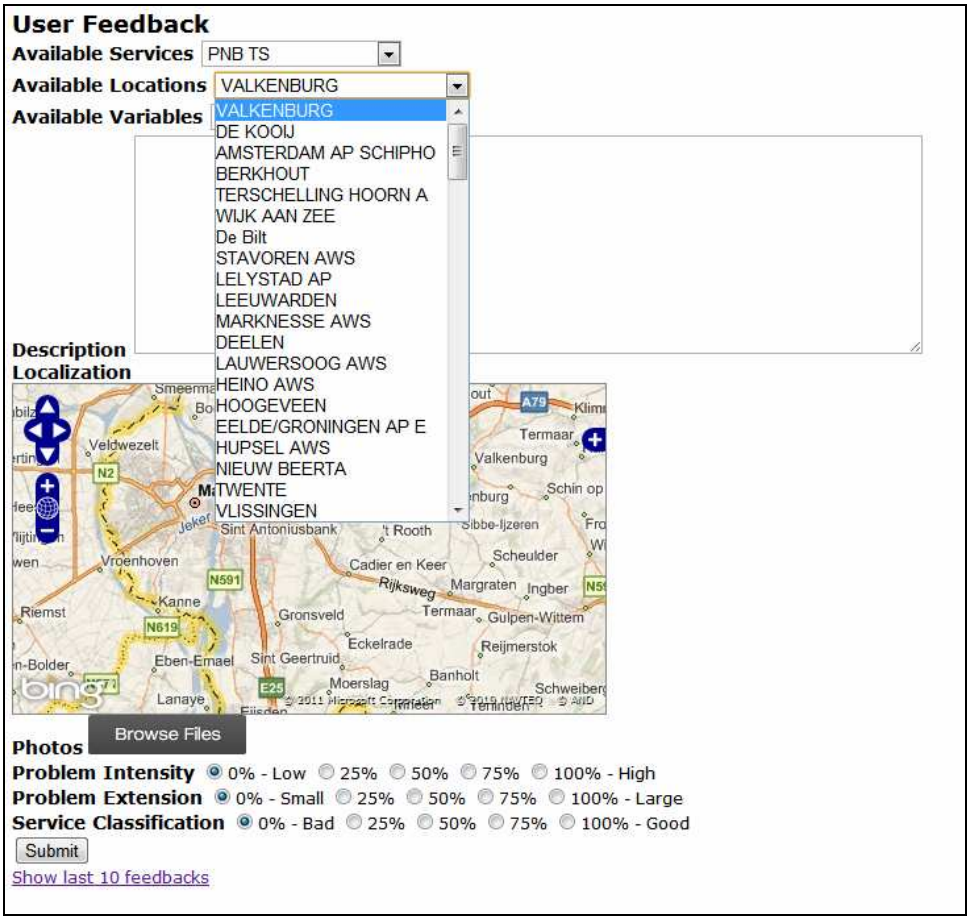


Figure 13 - User feedback portal gadget

This gadget is used to give user feedback to a specific gadget on the lenvis web portal.
A web portal gadget must be configured to have a user feedback to be able to use it. In that case, a user can click on a button in the gadget to give feedback. It will open a window with the shown user feedback gadget.

3.6. User profiling gadget

Upon registration, the user is flagged with a Yellow access level. If the user chooses not to submit the profile, he will still be considered a Yellow level user and as such will not have access to information tagged only with a Red access level. The user can effectively create, update, or delete his profile at a posterior time. If one of the previous actions were to happen, the access level for the user should be updated to mirror the actual (at the time) situation of his profile. If the user is not registered in the platform he is considered a Green level user and only has access to a sub-set of features and under an anonymous alias. For a user to have a Red access level, a data provider should add it to a list of known-and-safe users to access that provider data.

3.7. Polling gadget

The polling gadget enables users to vote on specific questions through the Portal and trough gadgets that wish to enable support for polls. As such, a poll can be added to a gadget through the

administrative pane, where the gadget creator must be able to define the poll question and the different answers from which a user can pick up one.

As for a Portal wide poll, there needs to be a gadget defined that should accommodate a poll and provide administrative access for maintenance. User voting is tracked by means of a cookie that stores the registered username and the polls this user has voted for. If a user has already voted on a poll and has a tracking cookie for it, he is presented only with the poll results to that moment and is not given a choice to vote.

3.8. EPS (Ensamble Prediction System) gadget

The EPS gadget has been developed to the EPS runs from the KNMI to the professional user. The EPS model predicts meteorological variables such as temperature, precipitation, and cloud cover for 10 days ahead. This information can be used by the professional user to see whether the precipitation will be high or low in the coming 10 days.

The gadget starts with a simple map of the Netherlands. The locations for which the EPS runs are calculated are shown in this map. When a user clicks on a location, a popup is created on top of the map and the EPS runs are shown in a graph.

The gadget has been created with OpenLayers as a JavaScript WMS client. The server for the gadgets has two handlers. The first handler is a WMS where the client connects with to retrieve the maps and the location ID's where the user clicked in the map (using GetFeatureInfo from the WMS). The second handler is a graph service that serves the graphs as images to the client. These graphs are custom made by the server so that the height and width of the image together with the ID of the EPS-station result in an image that fits into the gadget and belongs to the station that the user clicked. This handler connects to the Lenvis EPS TimeSerie service, which Hydrologic maintains as a generic connection between (remote) clients and the database at Hydrologic containing the EPS data.

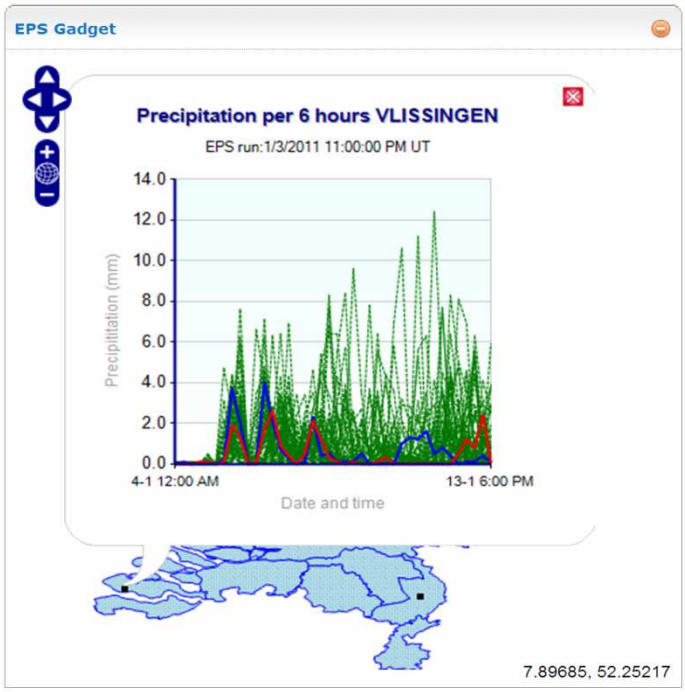


Figure 14 Numerical weather prediction model results for precipitation for stations in the Netherlands

3.9. Synops gadget

The synops gadget is suitable both for the professional user and the general public. This gadget is an interface to the meteorological data from the Synoptic stations of the KNMI in the Netherlands. These stations collect data about the precipitation, temperature, wind speed and direction and some other variables. This data is collected on an hourly basis. The gadget can be used by the general public to get an idea about the current weather and by the professional users to create graphs of a specific variable for a selected period.

The gadget starts the same as the EPS gadget with a simple map of the Netherlands where the user sees all the Synoptic stations. The user can click on one of these stations to get detailed information of this station. The icons on top of the gadget give an impression of the current weather by showing the temperature, wind direction, wind speed and the amount of precipitation in the past hour. Clicking one of these icons selects the variable for the chart.

The chart below these icons shows the development in time for the selected variable. The slider above the chart makes it possible to define the time frame for the chart. When this is done, the chart is rendered again by the handler and shown in the page. The user can save the chart image via the browser.

The gadget is implemented on the client side code with OpenLayers for the mapping and with jQuery for the user interaction with the chart. OpenLayers connects to a WMS at the Hydrologic web server to get the map images and to request the ID of a station when the user clicked on the map. jQuery is used to implement the slider to set the time frame and to make the ajax request to the chart service.

The server is made up of two handlers. The first handler is implemented the same way as it is for the EPS gadget. The chart service is more elaborated, because it also has to deal with the different time frames which the user can set. The chart service connects to the Lenvis TimeSerie Service, which is running at the Hydrologic web server to retrieve the input data for the charts.

Figure 15 Temperature graph from the KNMI Lelystad automatic station. The slider makes it possible to select the time frame for the graph and the icons above give access to the wind direction, wind speed and precipitation variables.

3.10. Water balance gadget

The water balance gadget gives access to the water balance model running at Hydrologic. The gadget can be used by both professionals in the water sector and the general public to get a quick overview of the current water balance for their area or the whole Netherlands. The users can get detailed information about the situation nearby by zooming to this area. The model which is used to generate the water balance calculates the accumulated difference between precipitation and evaporation. The input data for this model is the precipitation radar from the KNMI and evaporation comes from the EVAP data source of the KNMI.

The output data from this model are ASCII-maps, which are stored as plain files on the server. A WMS map gives access to all these model results by translating the raster datasets to images. The gadget is client side implemented with OpenLayers as a client to the WMS. OpenLayers reads the capabilities document from the WMS and parses the available dates for which a water balance map is available. These dates are made available in the toolbar on top of the gadget, where the user can set the date via the text boxes or scroll through the available days with the arrow buttons. The users can zoom to their area of interest by using the buttons in the top left corner or by dragging and scrolling with their mouse.

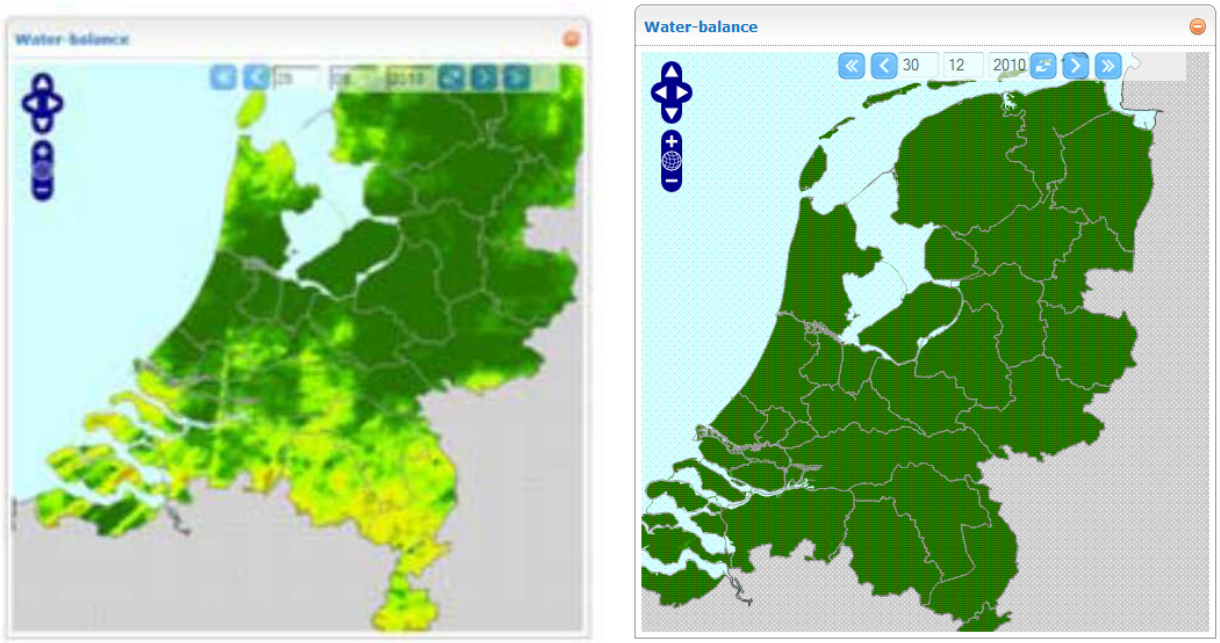


Figure 16 Water balance model. The left image shows a relative dry period during the summer where the dry parts have a yellow colour. The image on the right shows the situation in December where there is no water shortage and every part of the Netherlands has therefore a green colour.

3.11. Air quality gadgets

Air quality gadgets are written in Javascript and based on the OpenLayers library (OL) above Google map WMS layers or Google Earth api (GE):

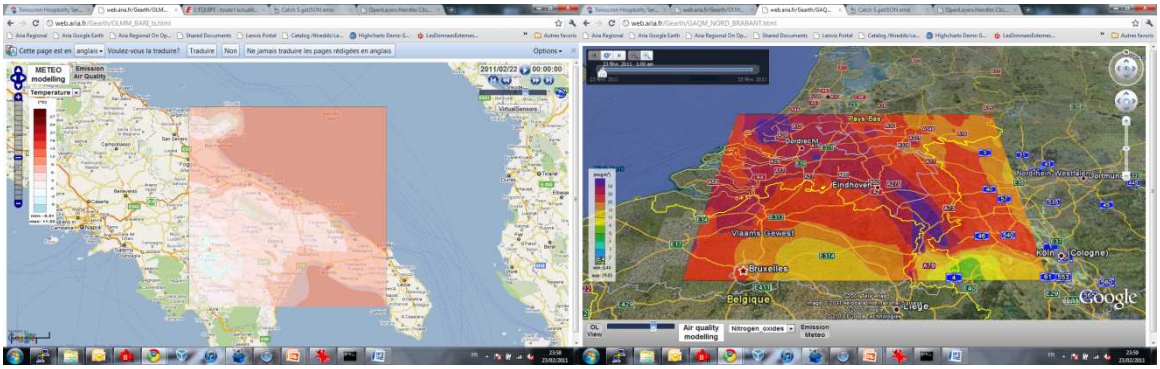


Figure 17 Gadget examples

For each case (Bari, Milan and North Brabant), two distinct widgets are developed for each model results:

- To display meteorological model results: GMM_BARI.html (GMM_MILAN.html, GMM_NOORD_BRABANT.html) and OLMM_BARI.html (OLMM_MILAN.html, OLMM_NOORD_BRABANT.html) are developed respectively with GE api and OL library;
- To display emission model results: GEM_BARI.html (GEM_MILAN.html, GEM_NOORD_BRABANT.html) and OLEM_BARI.html (OLEM_MILAN.html, OLEM_NOORD_BRABANT.html) are developed respectively with GE api and OL library;
- To display Air Quality model results: GAQM_BARI.html (GAQM_MILAN.html, GAQM_NOORD_BRABANT.html) and OLAQM_BARI.html (OLAQM_MILAN.html, OLAQM_NOORD_BRABANT.html) are developed respectively with GE api and OL library.

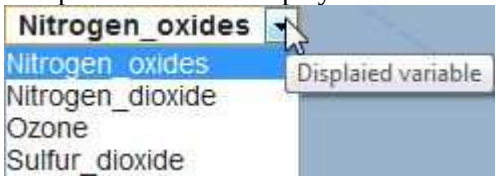
On each gadget:

- 

allows the user to switch between the different model results.
- 

and  allow the user to switch back and forth from OL to GE.

- Specific tools allow to span in space and time, zoom in and out, and play over the 48 hours of forecast. GE gives access to the topography with a 3D effect.
- The parameter to be displayed is selected through a combo box:



On the OpenLayer view, virtual sensors may be extracted from the model output provided on ARIA OpenDap Server (See details in Deliverable 5.1). The virtual sensor location is defined by a simple click on the map. The javascript application then calls a REST service developed by Hidromod. This REST service takes in argument domainid that qualify the model type and nesting

level, longitude and latitude coordinates of the target point, variable name, and the requested starting and ending dates. This REST Service invokes the LENVIS Grid Web services and renders a JSON object that is displayed in a chart.

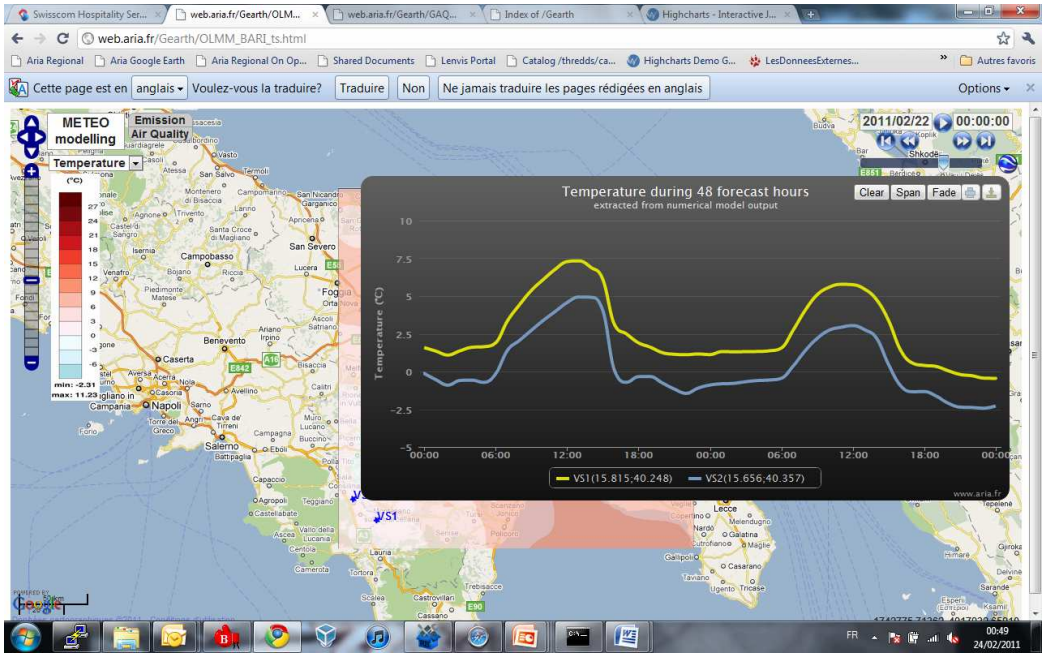


Figure 18 Temperature forecast

A maximum of 3 virtual sensors is allowed. The OL widget has been redesigned for smartphones as well. The smartphone web application runs on Iphones and Android smartphones.

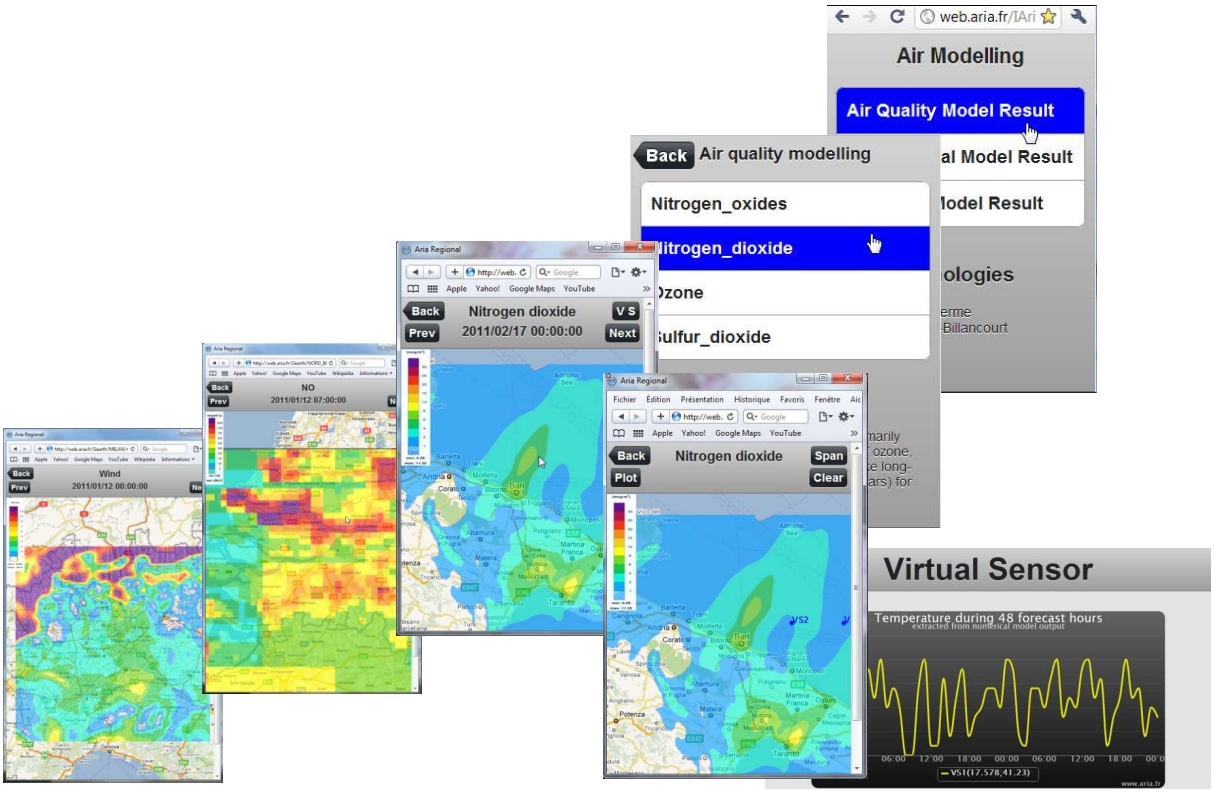


Figure 19 Gadgets shown in mobile phone

4. Mobile applications

4.1. Windows Mobile 6.x

Windows Mobile Application allows users to view a variable over time chart for a given location. All features are described in a typical application usage scenario below.

When the application is started for the first time, the user should go to Settings window and set chart preferences and his location. To set current user location, the user enters the "My location" tab in the Settings window and selects/unselects GPS option. If GPS option is not selected then the user enters address of his location. After the Search button is pressed:

- If GPS option is selected then current user location (longitude and latitude) is retrieved from the GPS device and displayed on the map.
- If GPS option is not selected then the location is searched according to the address entered by the user and displayed on the map.

Figure 20 Windows Mobile 6.x – Location settings

The next step is to set up chart settings. The user enters Charts tab in the Settings window, selects one of Area options: All or Neighbourhood. If Area-All option is selected then a list of all available Data TimeSeries Services is loaded. If Area-Neighbourhood option is selected then a list of Data TimeSeries Services, which provides data from the place closest to the user's location, is loaded.

Figure 21 Windows Mobile 6.x – Chart settings

When a Data Services list is loaded and a desired service is selected, then the users selects a location, variable for location, period of time and a chart type. After the OK button is pressed, data are retrieved from the selected data source and displayed on the chart.

Figure 22 Windows Mobile 6.x - Chart

Location and a variable of the chart are displayed above the chart. The user can change the preferences by returning to chart Settings window.

Users can provide feedback for the data presented in the graph. To do this, a user can enter the Feedback window, provide a description for the feedback, the location on the map, the photos that evidence the feedback, the intensity of a problem encountered, the extension of the problem and the

level of quality of the service (service classification). After that the user presses Send button and feedback will be sent to the Feedback Service, but if the user is not logged into the Lenvis network, then first he has to provide a username and password in a Login window.

Figure 23 Windows Mobile 6.x – Feedback (comments)

Figure 24 Windows Mobile 6.x – Feedback (photo)

On the Photo tab, a photo can be taken with a build-in camera or selected from the disc.

4.2. Android user feedback application

The Android feedback application allows users to check and report feedbacks about environmental situations present in the lenvis platform.

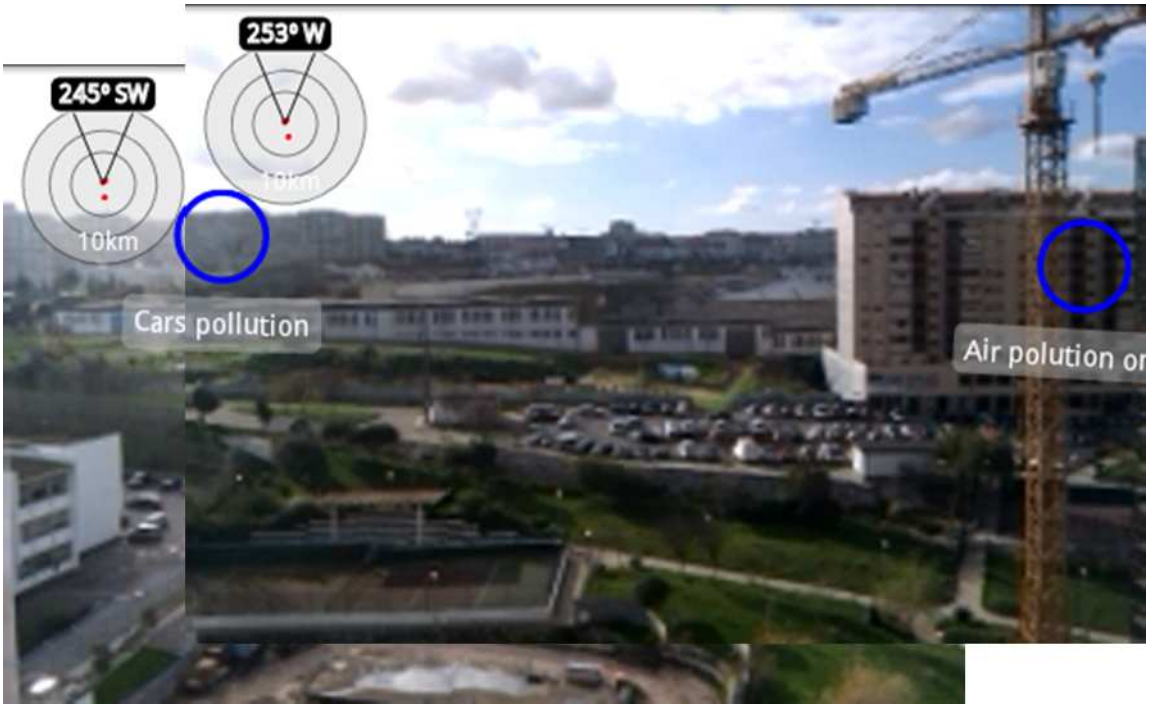


Figure 25 Composite image of Augmented Reality feedback screen

The application fetches all feedbacks made by a mobile application through the user feedback service, showing them in a list with some information to the user. There is also an option that allows the user to check the feedback overlaid on top of a real-time capture from the device camera.

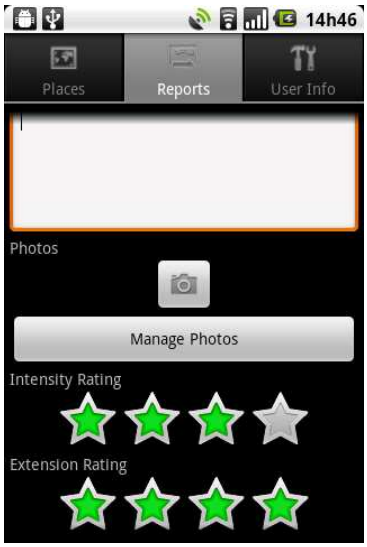


Figure 26 Feedback report

The user can submit a new feedback using this application through a form on which he can enter a classification for the problem and the service, a description and attach pictures taken with the phone.

A user can submit a feedback without being logged in or registered in the lenvis platform, since by doing so he is the equivalent of a Green level user.

4.3. Android bathing water quality application

The techniques and tools used for the Mobile Phone Development in Android for bathing water quality of fresh water lakes in the Province of Noord-Brabant are the following:

- Client side
  - Java based interface(Android)
  - Google MapView
  - GPS with Layar
- Server side
  - Apache web server (XAMPP)
  - PHP for server side scripting

The Google Android mobile platform builds on applications using Java programming. Currently augmented reality technique (Layar) offers one of the most innovative application areas that make optimal use of functionalities that are unique for smart-phones: GPS and Compass. Layer is used to locate fresh water lakes in the area (e.g. the nearest one), and check specific water quality information of these lakes (Khan, 2010).

The initial view of the developed Android Mobile Phone application for bathing water quality in fresh-water lakes in the province of Noord-Brabant in the Netherlands presents the user with three tabs: the first tab is for introduction and welcome to the application; the second tab leads to the presentation of monitoring or measured data in graphs and for displaying alerts; the third tab leads to interfaces for sending feedback messages both in text and data format.

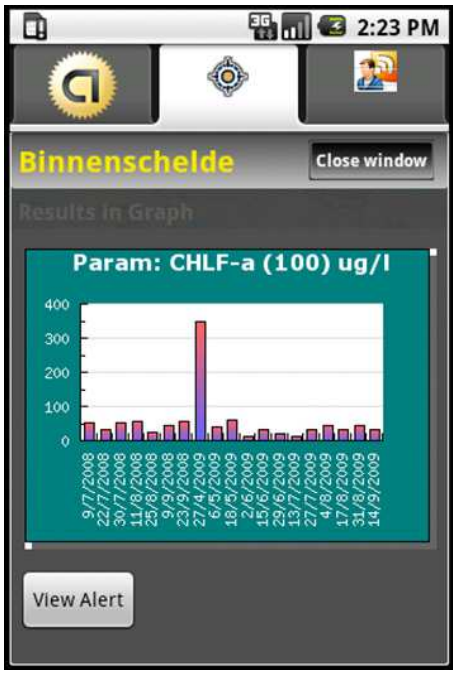


Figure 27 Graph Presentation on the Phone Application

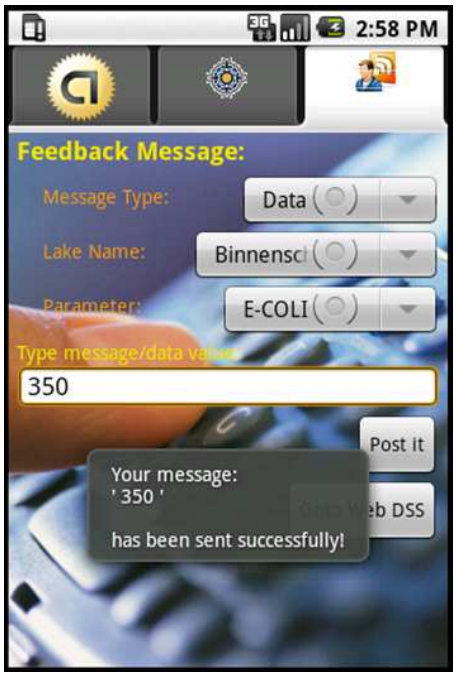


Figure 28 Sending numerical feedback (e.g. measurement data) for professional use

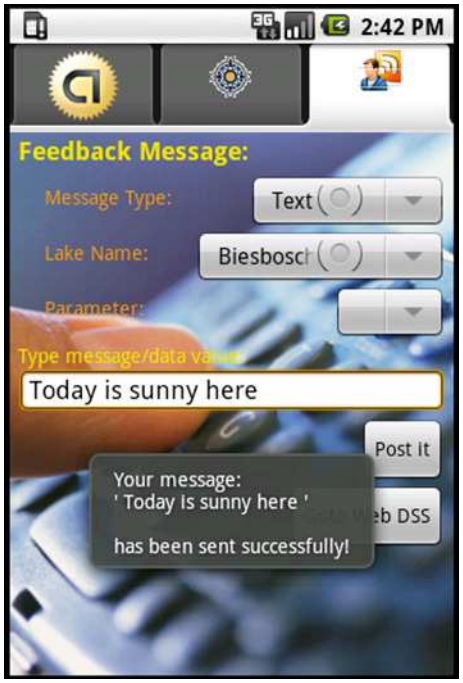


Figure 29 Sending unstructured free-text feedback (for public use)

Provision of feedback from users is implemented in the mobile phone application. With the developed application users can send their response from the field through their Android powered handset. Their response is sent to the central server, from where it can be retrieved for display in the web application. The sent data message is not displayed on the web at the same location with the text messages. Instead, it appears on the time series graph as a data point, with an indication that it represents data sent from mobile phone (annotated as 'Mobile Data'). Navigation to the web application from the mobile phone through the phone browser is easy on Android mobile phone.

With the Layer application, using GPS, all lakes are traced from any location, on the mobile screen through the use of the handset camera. The latest condition of the lake can also be displayed on the screen.

Figure 30 Layar application for fresh water lakes in the Province of Noord-Brabant

5. Desktop applications

5.1. Peer to peer application

Lenvis peer to peer application was developed in WP4 and like all others p2p, enables to share and download files. The idea is to use Lenvis p2p to distribute data and information produced by other Lenvis components like charting service, business intelligence, etc.

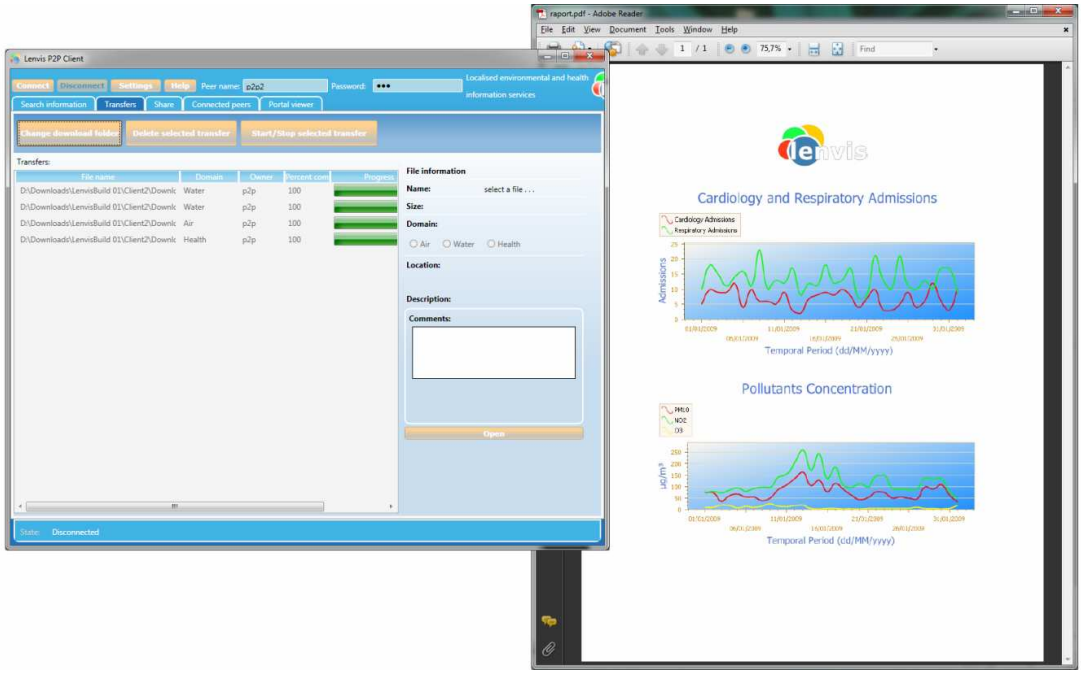


Figure 32 Lenvis P2P Application

The most important functionalities of lenvis p2p are:

- Search
- Download
- Share

Search

User can search a file he wants to download. To do so, he needs to provide at least one of following parameters:

- File name or part of it
- Domain
- Location

Download

To download a file, a user has to choose it from the search result list. The download progress can be seen on the transfer tab.

Share

A user can share a file with other users. To do so, he needs to provide full name of the file (with a path) and details describing the file content (domain, location etc.). Lenvis p2p application can be downloaded from the lenvis website. The detailed description can be found in D4.3 deliverable.

5.2. TimeSerie Client application

To help professional users have direct access to the data available in each TimeSerie service, a client desktop application has been developed. This client is able to list the available stations and parameters associated to one Time Series service. The tool presents the stations location (yellow markers) over a Google maps background. The tool also allows the user to do XY graphics. This tool is also useful for developers to test new time series services.

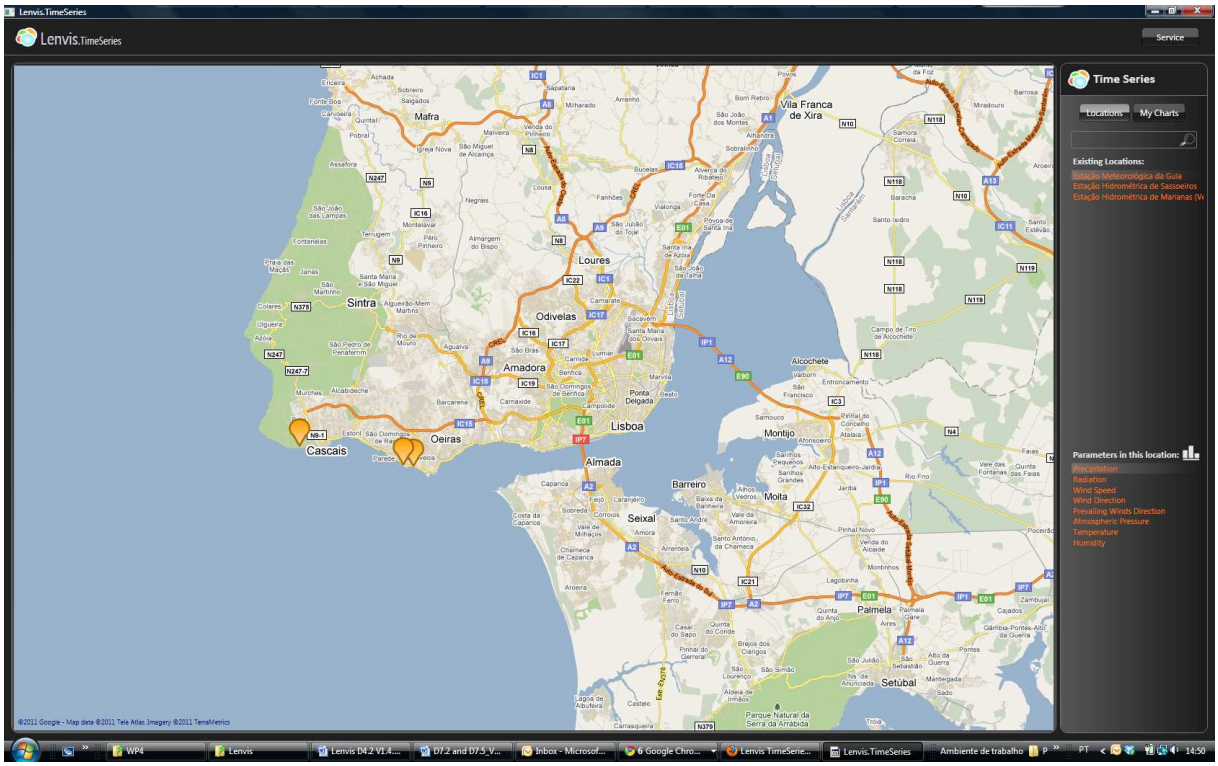


Figure 33 – View of the time series client. Left panel is the GIS view of the available monitoring stations via the open TimeSerie service. Right upper panel lists the monitoring stations available. In the right lower panel is the list of parameters available in monitoring station selected in the upper right panel.

Table 13 Description of the desktop application TimeSerie Client

Goal		To do a visual analysis of the data available through a Lenvis time serie service.
Description		This gadget allows the end user to do XY graphics of any parameter available through a time serie service implemented following the Lenvis contract
Location		Any location – The location is presented using inverted yellow drops over a Google Maps background (Figure 33)
Data	**Services**	Any Time Serie Service following the Lenvis contract
	Parameters	Any parameter available in each Time Serie Service
Access		Install a smart client available in the following site http://www.hidromod.com/Lenvis/Clients/LenvisTimeSerieServicesClient/index.htm . Whenever the tool is connected, updates are done automatically.
Users		Developers and professional users

6. Social networks

6.1. Twitter

On the Twitter portal an account is created named “lenvis_eu” (http://twitter.com/lenvis_eu). Also a special web service is created which allows Lenvis partners to post new statuses on to the twitter portal and to get a list of latest statuses from the twitter account. The web service specification can be found at http://lenvis.esaprojekt.pl/twitterservice?wsdl. It can be integrated for example into corporate websites to display latest statuses from twitter account or it can be used by data providers to publish some alerts etc.

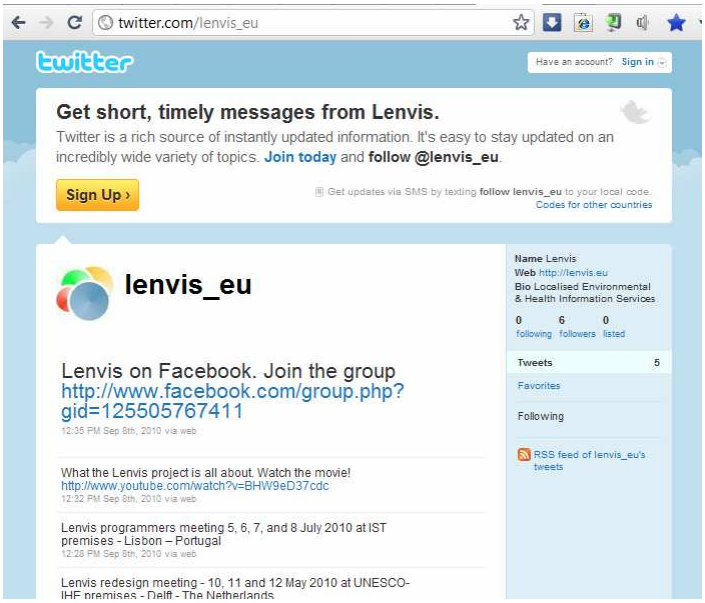


Figure 34 Twitter account

6.2. Facebook

On the Facebook portal a group is created where lenvis partners and other users, who join this group, can update and follow progress of the lenvis project. Users are also able to lead a discussion with others on the project or information provided by lenvis.

There is also a Facebook application which can be found at http://apps.facebook.com/lenvis_eu/. It presents a main idea of Lenvis projects and sample gadgets with environmental information. Facebook users can share this site with friends and add comments that can be posted to their Facebook profile.

Figure 35 Facebook group

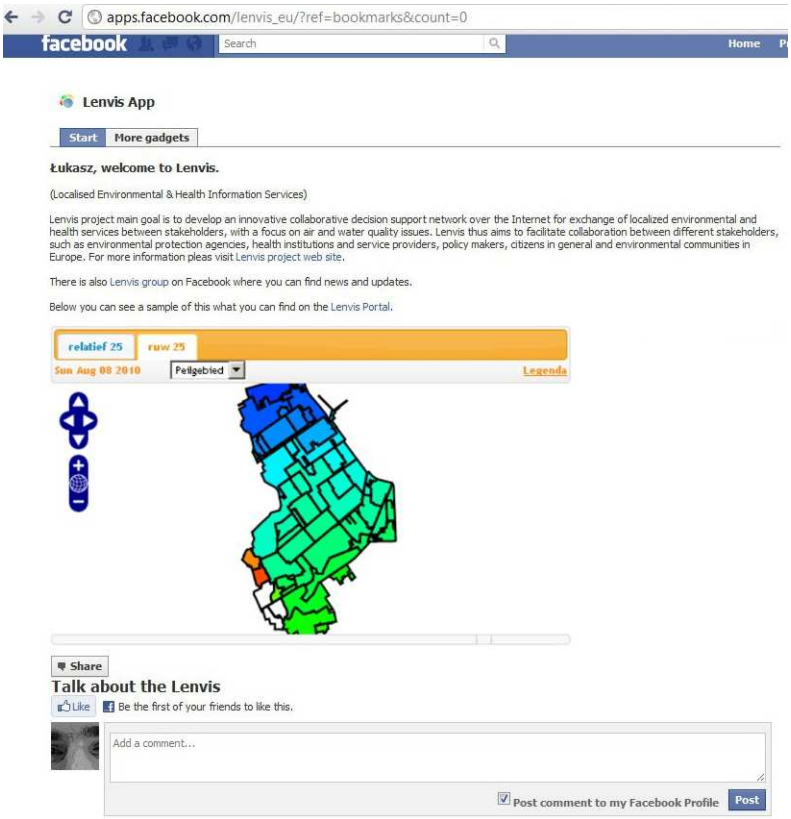


Figure 36 Facebook Application

7. Corporate websites

7.1. Surfers Oracle

The website www.SurfersOracle.com is a client, focusing in disseminating beach high quality marine forecasts among the surf community. In fact this site invokes the two gadgets: "Beach Lisbon Quality" and "Beach Lisbon Waves". To help the time series localization shown in the gadget "Beach Lisbon Quality", it is represented in the "Beach Lisbon Waves" by a black icon (surfer) showing the location of station represented in the XY graphics. The www.Surfers.com website characteristics are enumerated in detail in the following table.

Table 14 Description of the website

Goal		To provide the surf community state of the art physical and water quality three day forecasts.
Description		This gadget allows the end user to have access to the next 3 days forecast of physical and water quality conditions in three beaches and the wave conditions in the Tagus mouth area.
Location		Time series, for now three points (black figure representing a surfer indicates the location of the time series being watched): Carcavelos beach • Longitude: -9.34222 • Latitude: 38.68194 • Torre beach • Longitude: -9.32306 • Latitude: 38.67583 Santo Amaro de Oeiras beach • Longitude: -9.335 • Latitude: 38.685 Tagus mouth (wave conditions): Area : • North/West: 46.56232,-15.64125 • North/East: 46.56232,-1.35875 • South/East: 33.12183,-2.77075 • South/West: 33.12183,-14.22925
Data	**Services**	http://www.hidromod.com/Lenvis/MOHIDIST/LenvisTimeSerieServiceMOHID.svc (water quality and tide) http://www.hidromod.com/Lenvis/SWAN/ (wave conditions) http://www.hidromod.com/Lenvis/MM5/ (atmospheric conditions)
	Parameters	Wave Height, Wave Period, Tide, Wind Direction, Wind Speed, Water Temperature, Air Temperature, Water Quality
Access		http://www.surfersoracle.com
Users		General public (surf community)

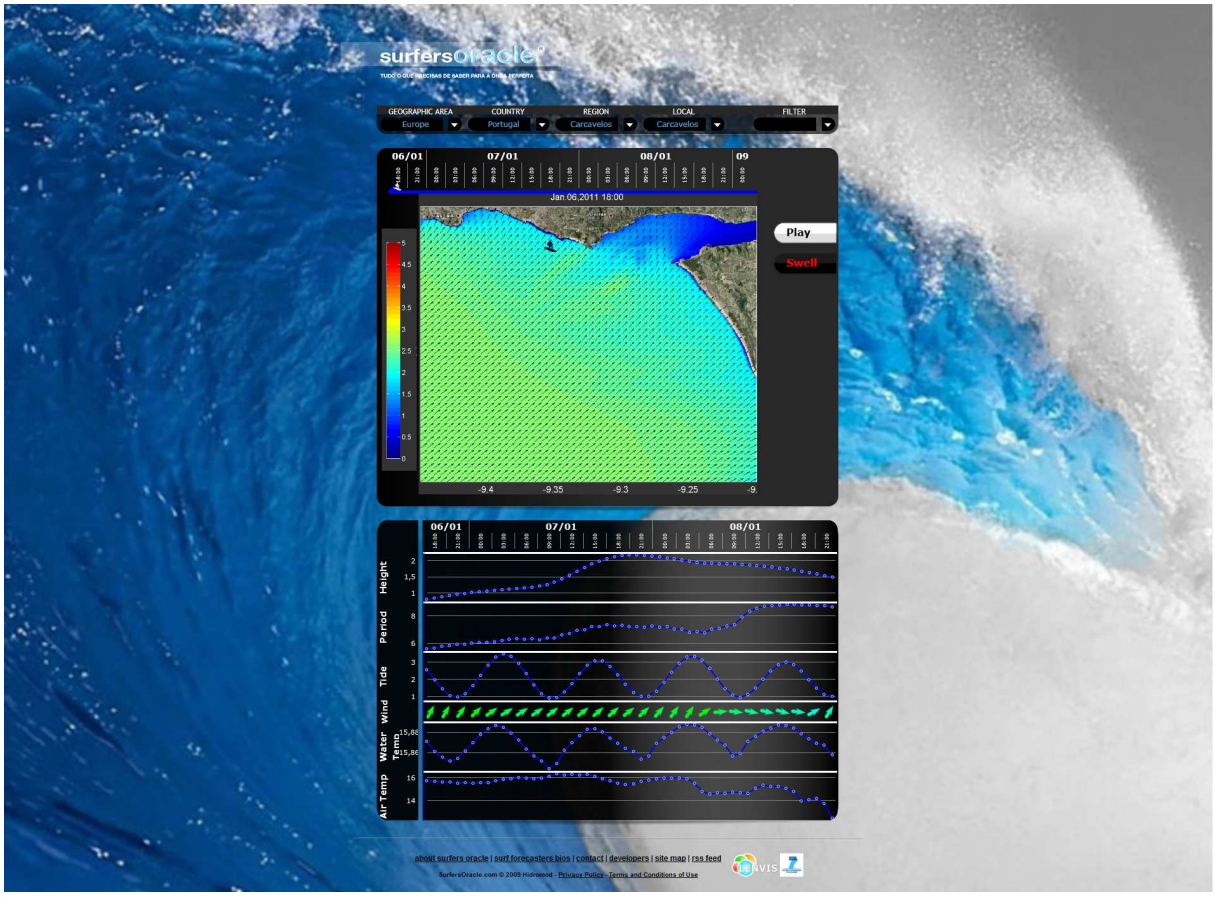


Figure 37 – View of the www.SurfersOracle.com site.

7.2. Model Service – Fecal emergency discharges

Graphical user interface (GUI) development is based mostly on the JavaScript libraries such as OpenLayers and jQuery. The GUI allows the user to explore the model results in an intuitive way using a web GIS environment, as is described in detail in deliverable D5.2. This web tool aims to allow professional users to explore grid services data in GIS environment. This tool also allows professional users to simulate the impact of sewer emergency discharges in the beaches' water quality. The web GIS modelling tool characteristics are enumerated in detail in the following table.

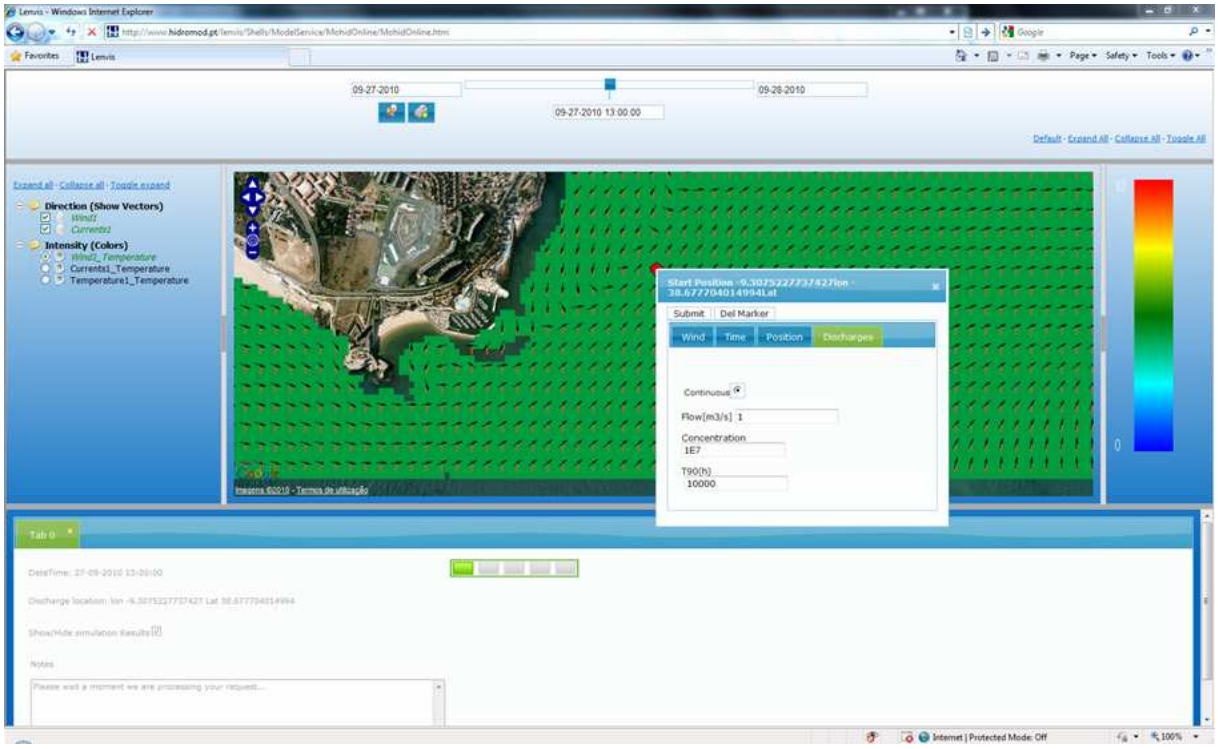


Figure 38 – View of the Web interface that gives Access to the Web GIS tool to explore the data available via a specific grid data service and to simulate the impact of a fecal discharge using the Lenvis Model Service.

Table 15 Description of the web GIS interface used to explore the data available via a specific grid service and simulate the impact of faecal discharges.

Goal		Without installing a tool (only via web) explore data available via grid services and to simulate the impact of faecal discharges
Description		This gadget allows the end user to explore model results in web GIS environment and to do simulate the impact of faecal emergency discharges
Location		Any domain location
Data	**Services**	Any Grid Service following the Lenvis contract and with the parameters enumerated in the next cell
	Parameters	Wind velocity, currents velocity
Access		http://www.hidromod.pt/lenvis/Shells/ModelService/MohidOnline/MohidOnline.htm
Users		Professional users

7.3. Bathing water – Brabant website

A dedicated website has been developed for communication with public users in the Province of Noord-Brabant about the fresh water recreational lakes and the up-to-date status of the bathing water quality in these lakes. Users can visit the website and in an easy Google Maps overview see the lakes in the province, select a lake, and intuitively find both meta-information and water quality indicators about the lake.

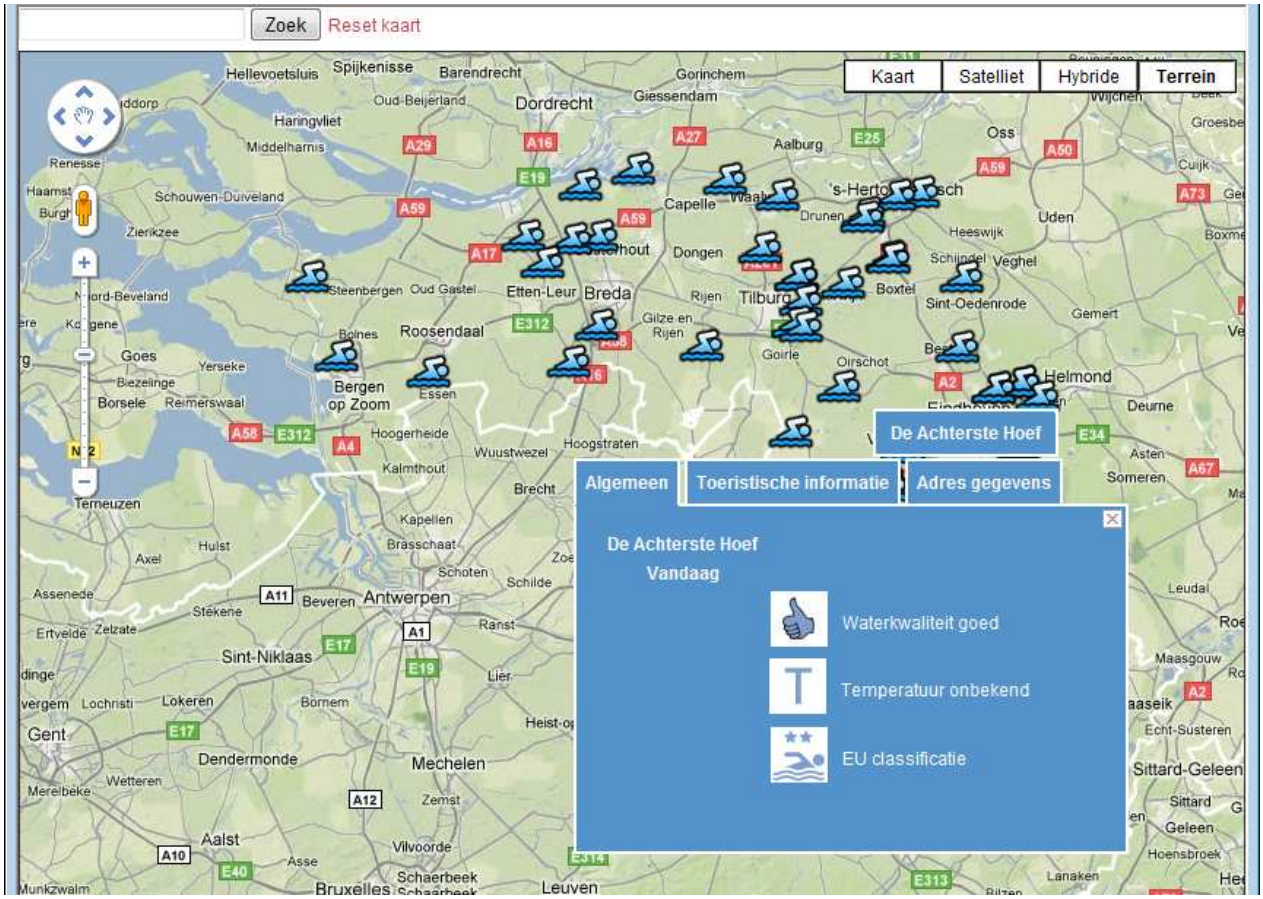


Figure 39 Bathing water website

Technologies used:

- Javascripts (AJAX). Javascript libraries of JQuery (http://jquery.com/)
- Php scripts to update and query data from the database
- Google Maps API's and
- Google Visualisation (Annotated timeline)
- Google directions are used (using the address of the lake as a parameter)

Database:

- JSON file that contains the metadata of each lake
- JSON file that contains the latest data for each WQ parameter
- MySQL database to store the new data coming and the address of each lake.

8. BI tools

BI toolset is designed to analyse data coming from lenvis data sources. It enables data exploration, leading to its transformation into information, and then into knowledge. The BI toolset used in lenvis is a REPOS system. REPOS is the reporting Business Intelligence tool used for visualizing data.

This BI tool consists of several components that cooperate to give the best results to the end user. The two main modules that a user can access through a user interface are Template Editor and Repos Web Portal. The first one is a stand-alone application and provides a tool which enable users to create a template in order to representing different time series. Instead, the Portal module is a .NET web application running on Microsoft IIS and allows users to publish the template created with the editor and share it with others members. The BI toolset can generate reports and analysis based on data stored in a Warehouse or generated by Data Provider Services. External systems can communicate with BI trough an Export Service that provides possibility to generate all predefined reports stored in repository. For a clear vision of the modules which compose Repos, the following section will describe the features and functionalities. The Template editor is a solution that enables to create reports; the whole application is user-friendly and it is equipped with an ergonomic graphic interface. Full process of report creation may be performed by means of the “drag and drop” technique as well as the use of inbuilt creators. Another important feature is that with Repos it is possible to make templates that later can be used many times. Finally, the Template Editor enables the user to define individual sections of the report, such as footer or header, as well as groups or total and partial summaries.

Repos makes it possible to generate standard reports and enables OLAP analysis. Thanks to this you can make an hypothesis and then verify it by means of detailed data profiles. Repos is able to generate reports based on standard databases, web services or OLAP cubes.

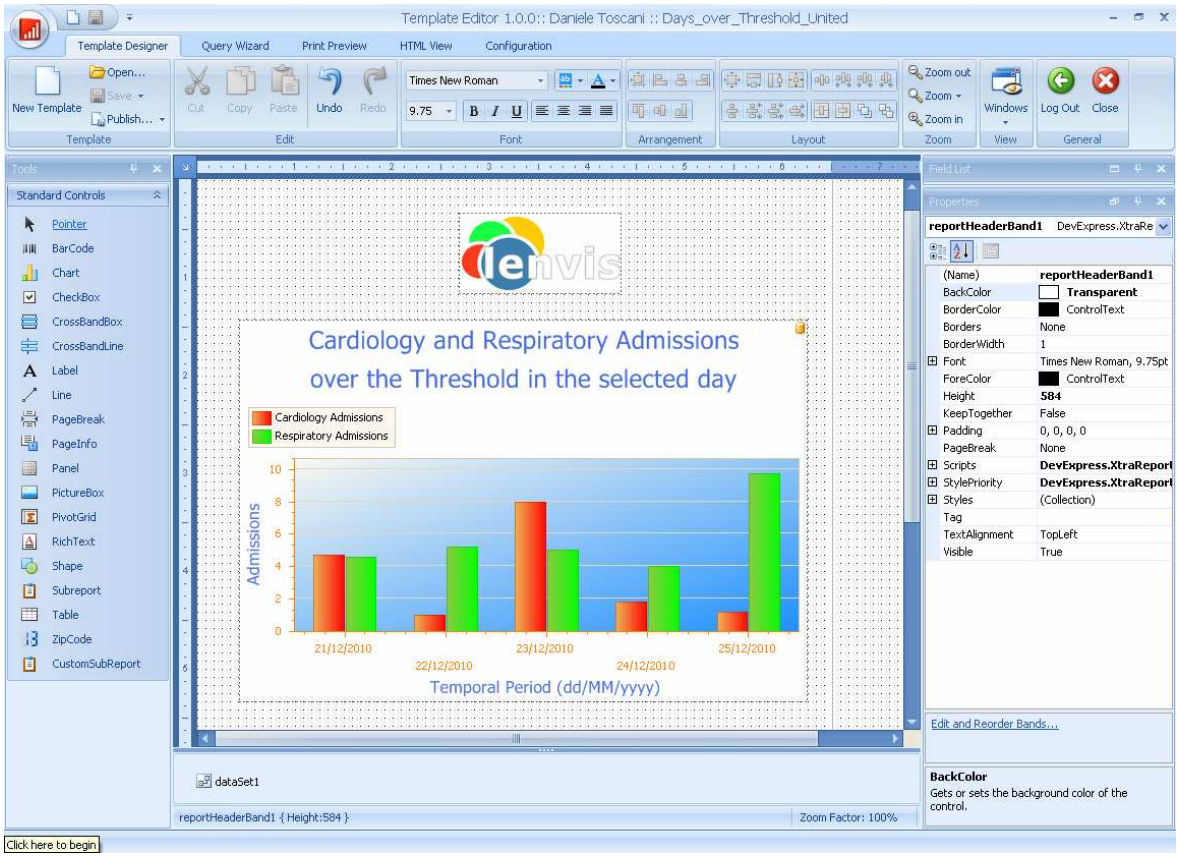


Figure 40 Template editor

The user can design the templates on the Template Designer tab. The figure above represents an example template created in order to report, in this case, the cardiology and respiratory admissions in a day of the week when a particular pollutant value is above the specified threshold.

The user puts the elements in the left panel on the template by drag-and-dropping them on it. Having finished designing the template the user can publish it on the Portal; it is a web application that enables report generation to a great number of users. Moreover, it enables to use templates that have been prepared before and to enter selected parameters. Therefore other users can use a template, which was prepared once; the output will be shown as represented in the figure below.

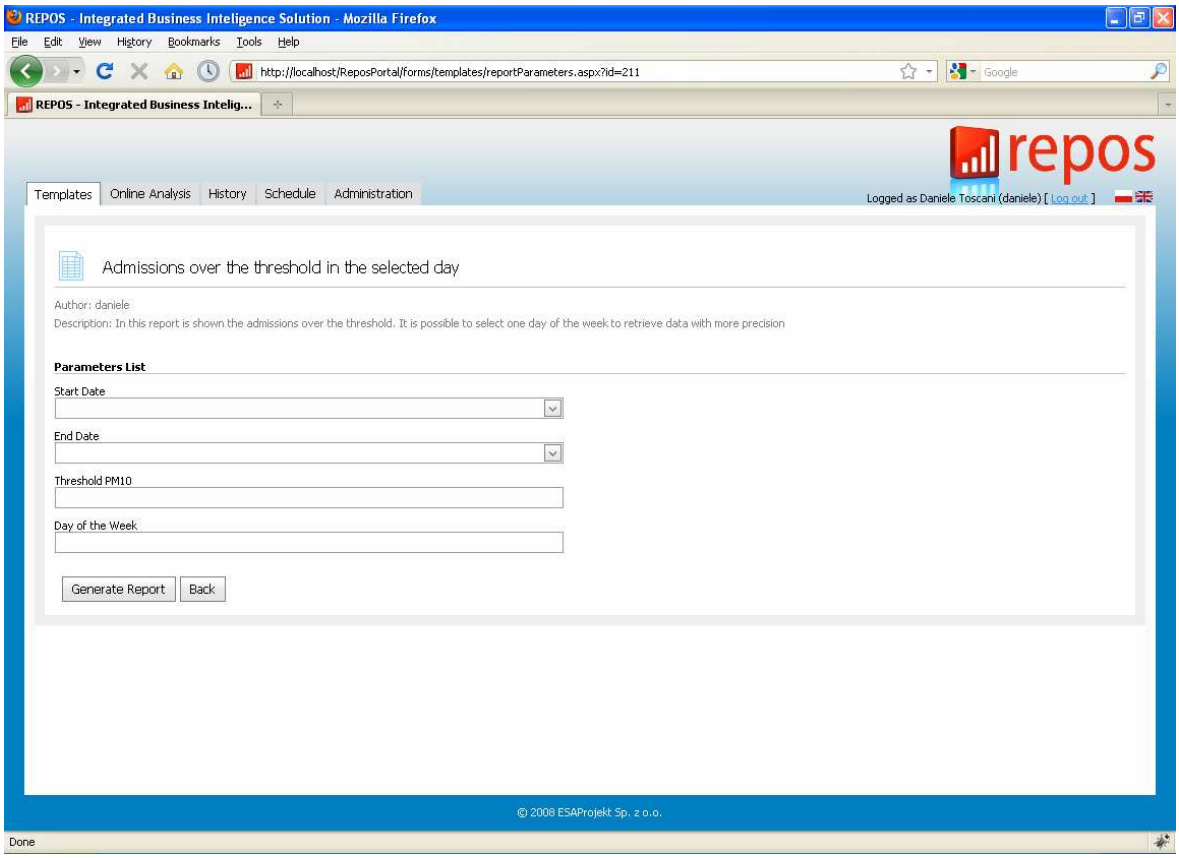


Figure 41 Repos portal

The web part of Repos is used as a Lenvis gadget. It enables end users to generate reports prepared in Template Editor. They can present data related to air, water and health domains in a graphical way. The most popular reports are graphs and charts.

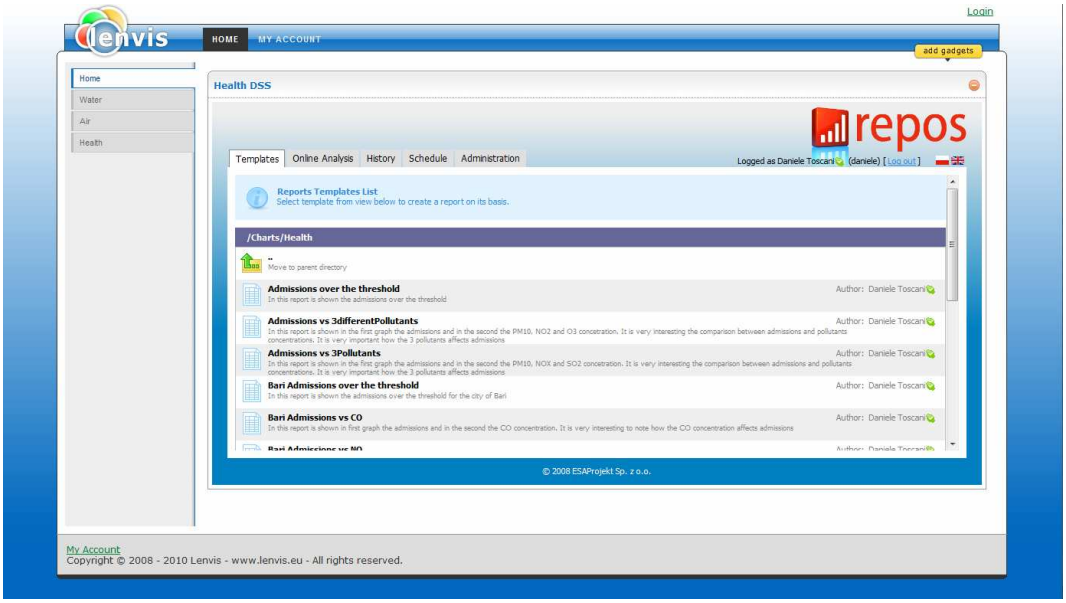


Figure 42 Repos gadget

A detailed description and the user manual of Repos System is included in deliverable D4.4.

Example of Repos Query

This section aims to introduce an example of a query generated by Repos. In particular, we consider this kind of subject: "All Pollutants for a given location and period". This is a one-to-one mapping with the ITimeSerieService GetDataByVariable method:

```
List<TimeSerie> GetDataByLocation(String locationId, DateTime startDate, DateTime
endDate);
```

The output returns the value of all pollutants for one defined location where the measurements have been done during a specified temporal period. The query is executed with the following parameters:

- temporal period: the first week of the year 2009, from 1 to 7 of January.
- location: Milan, Pascal.

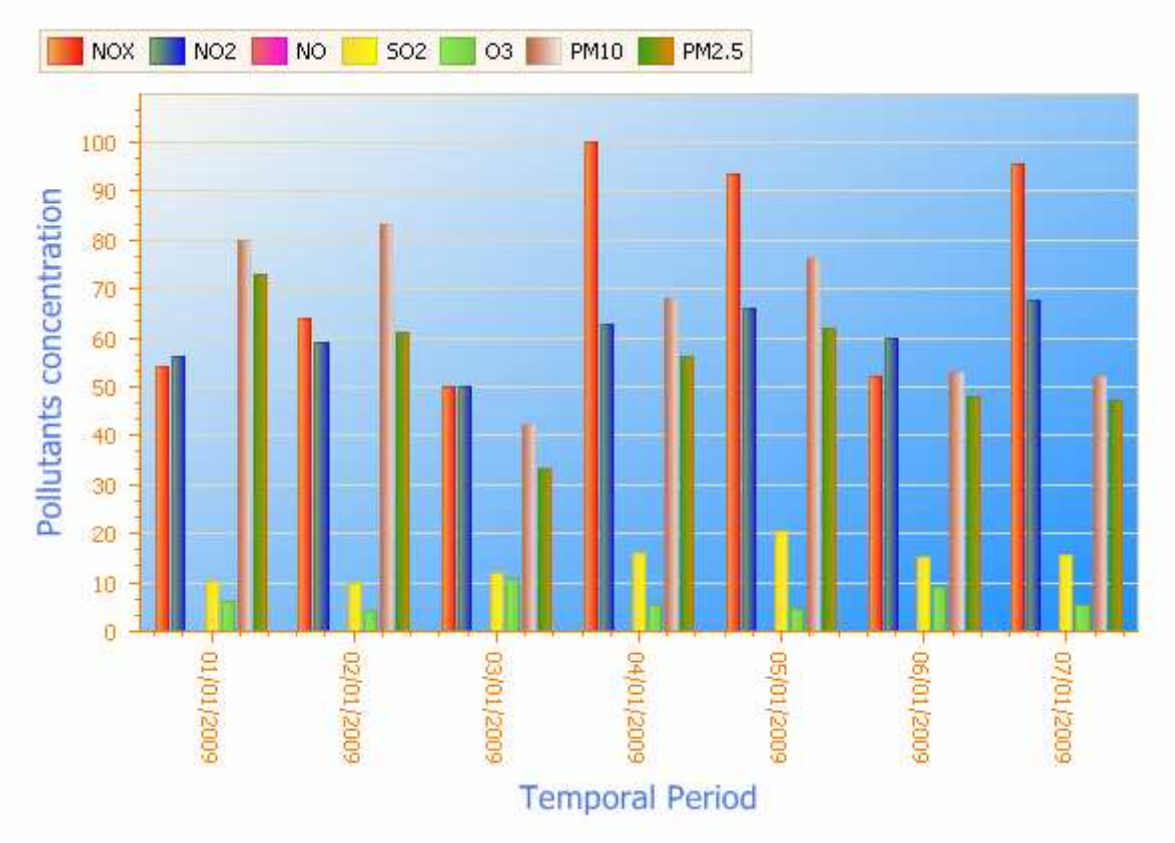


Figure 43 Pollutants values (from 1 January 2009 to 7 January 2009) measured in Pascal.

In the chart above it is possible to note that the highest value during the selected temporal period belongs to NOX (red line), while the lower value belongs to O3 (green line). Moreover, it is possible to note that the violet line (NO) does not show. The station has been probably switched off or does not work; for these reasons, the report of the NO concentration is not visible on the chart.